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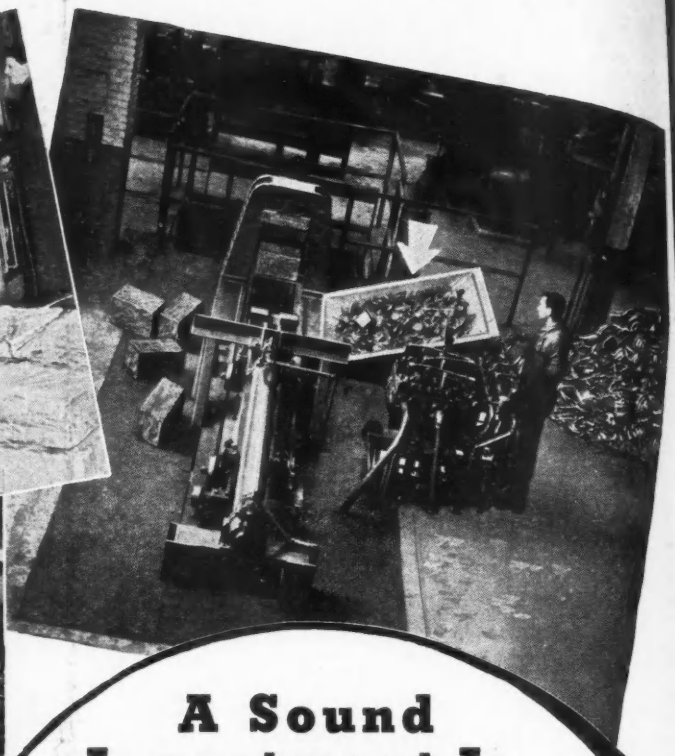

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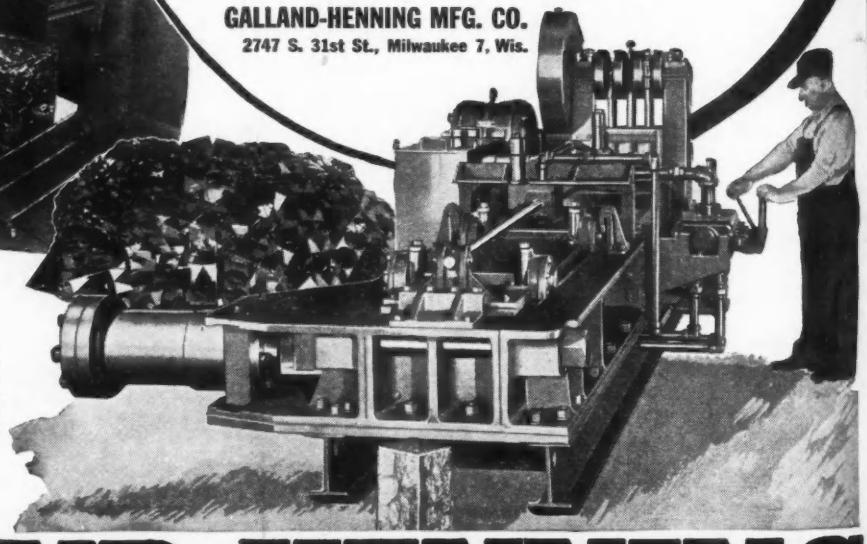

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AUTOMOTIVE and AVIATION INDUSTRIES

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Productivity---

The Only Source of Wealth

By Nicholas E. Peterson
Vice President, First National Bank of Boston

IT SHOULD be emphasized again and again that living standards depend upon the productive energy of workers, intelligently directed. This is clearly understood in a primitive society where the family makes its own clothing, provides its food, water supply and light, and builds its shelter. Under these conditions there are no illusions about the urgent need of each member playing his part. Stark necessity compels it. But in our modern and complex round-about economy there is much confusion about the source of wealth, wages, and standards of living. Of recent years in high Governmental circles the people have been told that Uncle Sam can provide an abundant life and security for everyone by the creation of purchasing power. Reduced to a simple formula it meant in effect that the Government would siphon money from taxes and borrowings and then distribute it back again through spending channels, thus establishing a perpetual force for sustained prosperity. This formula was accompanied by destructive national policies, including confiscatory taxation, arbitrary wage increases above those justified by productivity, strangling of free competitive markets, smothering of personal initiative, penalizing successful job makers, and the like. Some labor unions imposed limitations upon output and apprenticeships, indulged in "feather bedding" and slowdowns, insisted upon non-productive employment, demanded wage rates based upon "ability to pay" instead of productivity, and called a series of strikes that disrupted production, generated inflation, and threatened the public interest. Nor was management without blame. While the initiator of progress, management too often has failed to adopt modern methods and equipment, has neglected to utilize research methods, and in some cases has resorted to monopolistic practices and restricted output. All of these restrictive procedures have been reflected in lower productivity.

In the past these obstacles to productivity were not of grave concern and were taken in stride. But with the trying problems inherited from the war, including a staggering Federal debt and an estimated normal peacetime budget that may be more than three times the pre-war average, we must adopt policies that implement productiveness in all fields of endeavor. This is imperative in order to assure the survival of our private enterprise system. Moreover, the course of world affairs will in large measure be determined by how successful we are in maintaining a sound economy in this country.

The labor group should be the most concerned about increasing the productivity of our industrial system. During the past three decades or more, the trend of real wages has corresponded closely to increased output per manhour.

(*Turn to page* 88, *please*)

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RYERSON STEEL

Aircraft Industry Makes Good Progress in 1946

Takes on guided missiles projects

By Robert McLarren

THE aircraft manufacturing industry, after being badly mauled by war contract cancellations, hard hit by reconversion problems, costs and losses of personnel, repeatedly investigated individually by Congressional probes, threatened by the draft and attacked unmercifully by the press and public, has managed to pull through an extremely critical year in its 35-year history and emerge in an astonishingly solvent and promising position. Although some point to its precipitous slide from its wartime position as a sixteen-billion-dollar-a-year industry, the largest in the world, to its current one-billion-dollar-a-year volume, it is significant that this latter total is far greater than the total volume of all the years of its history prior to World War II.

The industry has emerged from the contract cancellations crisis virtually intact, in sharp contrast to the end of World War I, when the cancellation of contracts for 61,000 airplanes valued at five billion dollars wreaked havoc with the industry and forced all of its companies either into bankruptcy or through complete reorganization. Only Curtiss, of the major World War I quantity producers, emerged solvent and continued in business following a realignment of its corporate structure.

Several factors have contributed to this survival of the industry, chief of which has been the astute contract settlement policies of the Government, which permitted equitable payments for work-in-process, speedy processing of claims and liberal plant-clearance procedures. The surplus problem, which plagued the World War I industry for more than a decade, has been handled with clearness and dispatch. The third major factor has been the maintenance of military procurement on "interim air force" types and a sizeable procurement on experimental and development work.

More detailed figures are now available on the extent

of contract cancellations at the end of the war. On Aug. 16, 1945, the day following the surrender of Japan, a total of 9968 termination notices was sent to 2700 contractors announcing the cancellation of contracts valued at $7,000,000,000. In the following two weeks terminations continued and during the month of August, 1945, the Army Air Forces cancelled 10,263 contracts worth $7,535,986,000. During this same month the Navy Bureau of Aeronautics cancelled a total of 5597 contracts valued at $3,099,280,000. These terminations were in addition to those earlier in the year following the end of the war in Europe and the redeployment for a one-front war against Japan. For the total of 1945, Army and Navy cancellations included 24,538 contracts involving $26,598,873,000 worth of aeronautical materiel.

Current Backlog of Aircraft Manufacturing Industry

Company	Military	Commercial	Total
Bell	*	*	$69,000,000
Boeing	$65,000,000	$60,000,000	131,800,000
Commonwealth	none	40,000,000	40,000,000
Consolidated-Vultee	236,115,000	28,795,000	264,910,000
Curtiss-Wright	86,000,000	none	86,000,000
Douglas	*	*	162,000,000
Fairchild	*	*	72,500,000
Globe	*	18,000,000	18,000,000
Grumman	76,000,000	none	76,000,000
Kellett	*	*	5,400,000
Lockheed	144,000,000	55,000,000	199,739,000
McDonnell	22,000,000	none	22,000,000
Martin	26,000,000	149,000,000	175,000,000
Menasco	*	*	8,400,000
North American	75,000,000	15,000,000	90,000,000
Northrop	53,500,000	none	53,500,000
Piper	none	26,000,000	26,000,000
Republic	66,950,000	7,050,000	84,000,000
Ryan	*	*	33,000,000
United Aircraft	*	*	92,800,000

* Not available.

As impressive as these figures may seem, the significant fact is that contract cancellations did not stop with V-J Day. Terminations continued as plans and policies for the postwar military establishments crystalized. By February, 1946, the Army Air Forces had cancelled a total of 16,112 contracts involving $15,625,456,000 and up through June 30 of this year, the end of the 1946 fiscal year, cancellations totaled 27,133 contracts valued in excess of $21,000,000,000.

Settlement of Claims

The speed of reconversion quite probably can be attributed to speedy claims settlement more than any other factor in the aircraft manufacturing industry. For example, of these 27,133 contracts, nearly 27,000 have been settled at a cost to the Government of $1,278,794,000. Only about 155 claims remain to be settled having a value of $1,960,000,000. That dollar size is a poor index to rate of claims settlement is shown by the fact that half of this total is contained in a case with a single company. A more accurate index is provided by the fact that two years ago it required eight months, on the average, to settle a claim whereas settlements are now being executed on the average of two and one-half months per claim.

Of a total of 61,239 plant clearance requests up to May of this year, a total of 60,252 has been completed and only 42 requests were in process over 60 days old.

Although tremendous credit must be given Army and Navy termination officers and civilian personnel for this speedy processing, the industry itself played a vital role in the job. At the suggestion of Government termination agents, aircraft manufacturers organized special staffs to aid in the work. A contractor training program was instituted and a total of 34,000 war contractors participated. In addition, 144 carefully picked six-man "termination teams" were utilized to straighten out processing that had become snagged by local officials.

Surplus

One of the largest shadows that threatened the industry following V-J Day was surplus aircraft and equipment. This fear grew out of the holocaust of World War I surplus disposal which reduced the industry to insolvency through lack of business and produced hundreds of ill-famed "war profiteers" who, although not in any way connected with the industry, managed to involve it in public disrepute. A strong, and carefully-controlled, surplus disposal policy following World War II has prevented the formation of such scandal as was produced following World War II. More than 25,000 surplus aircraft of all types have been sold in the United States since V-J Day and the market is still strong. Of this total, 16,097 have been civilian-type aircraft including 8702 primary trainers, 4279 basic and advanced trainers and 3359 liaison types.

The mushrooming of non-scheduled operators (mostly veterans) has played a major role in the surplus picture and they have provided an unexpectedly strong force in taking up the slack on multi-engine transport planes, a problem which might have grown serious for the industry had the scheduled air transport industry absorbed all the surplus transport planes. Nearly 2000 surplus multi-engine transport planes have been purchased from war stocks by independent groups.

Another important source of surplus sales has been foreign purchasers. A total of 4423 aircraft have been disposed of abroad by the Foreign Liquidation Commission. Of this total, more than 3000 have been transport aircraft acquired by 60 foreign airlines, governments and individuals on every continent. A total of $82,000,000 worth of surplus aircraft has been sold abroad, including $7,000,000 worth taken from surplus stocks in the United States. According to the FLC: "There are virtually no passenger or cargo air-

lines in the world today which are not operating either entirely or in part with American surplus equipment."

Both the Army Air Forces and the Bureau of Aeronautics have continued production on selected combat and service types since V-J Day and this procurement has constituted a strong foundation on which the industry leans while solving its manifold reconversion problems and the development of commercial types and markets. Total military production during the first seven months of 1946 was 704 aircraft of all types and a total of 1600 military planes are scheduled for delivery during the year. Although this quantity is less than one-fifth a single month's production during the war, it has provided income and employment for an essential nucleus of the industry on which future expansion can be built. The following types are in quantity production:

Army Air Forces

Lockheed P-80	25 per month
Fairchild C-82	8 per month
Lockheed C-69	Upon completion
Douglas C-74	Upon completion
Boeing B-50	Upon completion
Northrop B-35	Upon completion
Consolidated-Vultee B-36	5 per month
Republic P-84	20 per month

Naval Aviation

Grumman F7F	14 per month
Grumman F8F	22 per month
Vought F4U	21 per month
Lockheed P2V	6 per month
Martin PBM	5 per month
Edo OSE	Upon completion
McDonnell FD	Upon completion
Martin BTM (AM)	8 per month
Douglas BT2D	21 per month
Curtiss BT2C	Upon completion

In addition, experimental and development contracts are now in process for several new Army and Navy types. These contracts authorize the construction of from one to several hundred of the following:

Army Air Forces

Curtiss A-43	Vultee A-44
North American B-45	Consolidated-Vultee B-46
Boeing B-47	Martin B-48
Northrop B-49	McDonnell P-85
North American P-86	Curtiss-Wright P-87
G & A R-9	Rotor-craft R-11
Bell R-12	Bell R-13
Bell Supersonic	Douglas Supersonic

Naval Aviation

North American FJ	Martin P4M
McDonnell F2D	Lockheed R60
Curtiss F15C	Ryan F2R
Vought F5U	Vought F6U
McDonnell HJD	Piasecki HRP
Douglas Supersonic	

The expansion of overseas routes, tremendous increase in passenger-miles and the growing competition of the airlines have demanded the purchase of additional new equipment of modern design. With rates and routes fixed, the airlines' only hope for increased business lies in the utilization of faster, lower cost and more comfortable transport aircraft and this has created a vast market for new multi-engine transport aircraft. As of July 1 the airlines had ordered a total of 585 new aircraft, many of which are still in the design stage. These new types fall into three broad categories:

(1) Wartime types improved and in production. These types include the Lockheed Constellation, of which 52 are scheduled for 1946-47 delivery; the Douglas DC-4, of which 11 are scheduled for 1946 delivery; and the Douglas DC-6, of which 128 have been ordered for 1946-47 delivery.

(2) Postwar models in the medium-size category. These include the Martin 202 and 303, of which 327 are on order; and the Consolidated 240, of which 200 have been scheduled for 1947 delivery. In this category also are the Lockheed Saturn, Boeing 417, Douglas DC-8 and various Beech, Cessna and Stinson feeder-line models for non-scheduled and short-haul airline work.

(3) Postwar "super" liners. These include the Boeing Stratocruiser, of which 38 are scheduled for 1947 delivery; Republic Rainbow, of which 38 are on order and the monster Consolidated-Vultee Model 37, of which 15 have been ordered.

Personal Aircraft Production

The lightplane manufacturers have demonstrated typical American competitive enterprise since V-J Day and threaten to make good on the most optimistic claims made for them. For example, following V-E Day the lightplane industry produced 10 planes in July and 38 in August. By October, 1945, this had mounted to 401 and a total of 797 was produced in December, a grand total of 2047 during the year 1945. Production continued to mount at a fantastic rate and a total of 13,500 had been delivered by July 1, 1946. Total production will approximate 35,000 this year, a truly remarkable performance. A total of 46,925 orders, backed by deposits, are now on the books of the personal aircraft manufacturers with the list mounting daily. Indicative of this mushroom growth of private flying is a 1000 per cent increase in civil pilots since the last prewar year. A total of 342,418 citizens now hold certificates licensing them to fly. That this is only the beginning is shown by the 64,253 student pilot certificates issued by the Civil Aeronautics Administration in the first six months of this year. These pilots and students owned and operated a total of 57,488 airplanes on July 1, 1946.

As optimistic as production figures might seem, they are far short of what they might have been had not labor difficulties seriously disrupted the flow of vital

(*Turn to page 76, please*)

Value of Aircraft, Parts, and Equipment Produced in United States *(Shipments, in thousands of dollars)*

1946	Total	Complete Aircraft		Aircraft Parts and Equipment	Engines and Parts	Propellers and Parts	Instruments
		U. S. Military	Other				
January	$57,315	$25,807		$11,126	$16,135	$1,506	$2,741[a]
February	60,784	16,510	17,536	11,319	11,847	1,183	2,389
March	64,858	17,040	20,178	9,599	12,803	1,837	3,401
April	83,809	27,520	20,408	12,747	16,909	2,446	3,779
May	85,264	19,876	29,147	10,749	20,418	2,317	2,757
June	72,594	11,387	25,346	12,066	19,147	2,124	2,524

[a] Corrected figures. Source: Civilian Production Administration—Bureau of the Census, Facts for Industry, Series 50-3.

The Proposed PICAO

for Commercial Aircraft

THE Airworthiness Division of the Provisional International Civil Aviation Organization at its first session held at Montreal in March and April confined itself to formulating the more important airworthiness standards for commercial airplanes used for carrying passengers on scheduled services. Provision has been made for the progressive enforcement of the standards, subject to amendments and additions, beginning Jan. 1, 1951, for all individual airplanes newly introduced into international navigation and carrying persons for hire or reward on scheduled services, and beginning Jan. 1, 1954, for all airplanes engaged in international navigation and carrying persons for hire or reward on scheduled services.

The phrase "all individual airplanes newly introduced into international navigation" is intended to cover airplanes of new design, newly constructed airplanes of old design, and all individual airplanes—whether old or new—which are used for the first time for international passenger transportation, for example, military airplanes converted to civil use.

Important proposed design and test standards have been selected from the final report of the Division for publication here. Since the purpose is not to present the entire report in its original form, but rather to give data useful to engineers and company executives, the order and manner of presentation have been modified slightly. The standards follow:

Reciprocating Engine Tests

A single engine of the design and configuration submitted for approval shall satisfactorily complete at least the calibration, endurance, operation, and detonation tests prescribed in the following paragraphs. If desired, a second engine of the same type may be used for the vibration test. At least the essential accessories shall be installed during these tests. These tests shall be conducted in the order in which they are described. Before starting and after completing the tests, a full strip examination of the engine, including measurements of wear and distortion, shall be made and recorded. Divergence from this general requirement may be permitted, if the nature of the engine to be tested is such as not to necessitate a strip examination before the start of the test.

VIBRATION TEST—A vibration test shall be conducted to investigate crankshaft torsional and bending vibration characteristics over the operational range of crankshaft rotational speed and engine power normally used in flight, including low-power operation, from idling speed to 105 per cent of the desired take-

Part I

This article presents Test Requirements for Aircraft Engines and Propellers.

Airworthiness Standards

in International Service

off speed rating. The test shall be conducted with a representative flight propeller. If excessive vibration is found to be present in the operating range of the engine, suitable remedial measures shall be taken prior to endurance testing. If moderate vibration is found to exist in the operating range, instead of taking remedial measures it will be permissible to conduct a vibration penalty test on the same engine used for the endurance test. This run shall be conducted after completion of the endurance test, but prior to the operation test, and shall include sufficient operation under the most adverse vibration condition to establish the ability of the engine to resist fatigue failure.

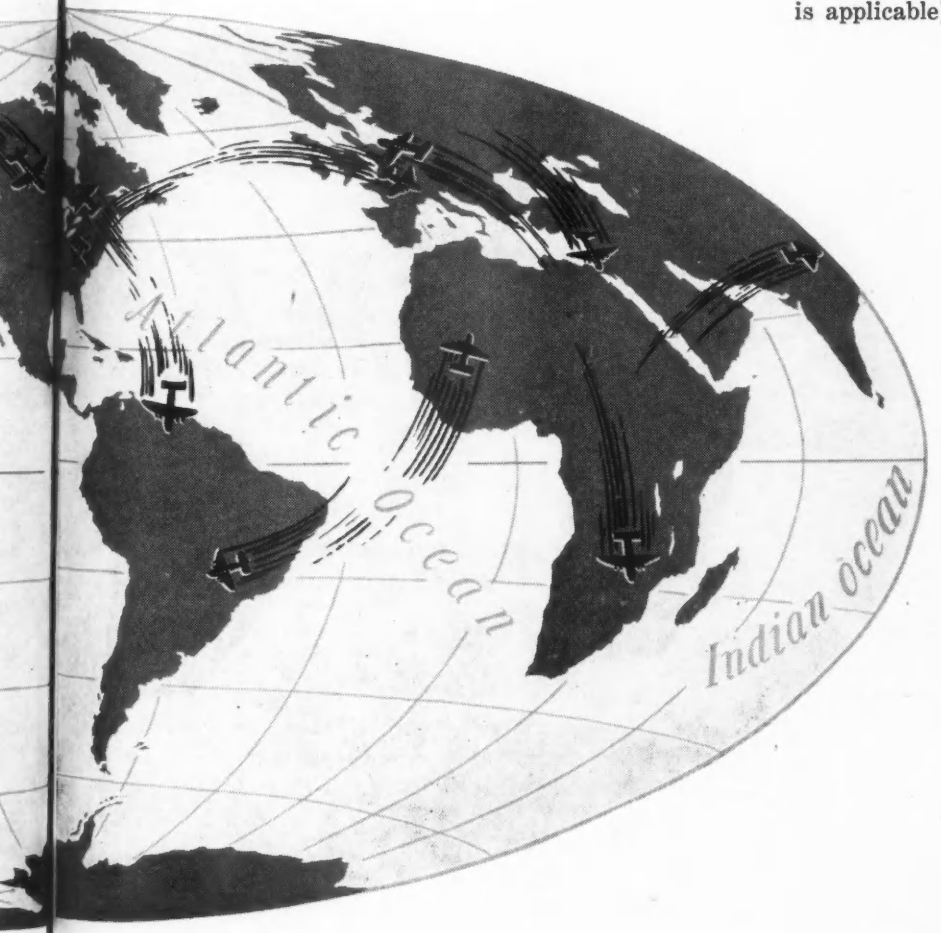
CALIBRATION TEST—The engine shall be calibrated, after being properly run-in, to establish the power characteristics for purposes of rating, and to determine the endurance test conditions. The results of this test shall constitute the basis for establishing the power and detonation characteristics of the engine over its entire operating range of crankshaft rotational speeds, manifold pressures, and fuel/air mixture settings, and for establishing its altitude performance characteristics. All accessories not required for engine operation shall be disconnected during this test.

DETONATION TEST—A test shall be conducted in which the engine is operated throughout the range from the lowest crankshaft rotational speed intended to be used for cruising, to the rotational speed used for take-off. During this test, full throttle, or the maximum manifold pressure permissible (whichever is applicable), the leanest specified mixture strength, the maximum oil-inlet temperature, the maximum cylinder-head or coolant-outlet temperature (whichever is applicable), and the highest permissible intake-air temperature shall be used in combination, to determine whether the engine can function without detonation throughout its range and intended conditions of operation. If desired, this test may be carried out in conjunction with the calibration tests.

ENDURANCE TEST—The endurance test shall consist of 150 hr of operation as follows. The test shall be run in such periods as may be considered acceptable. A representative flight propeller shall be used during this test. Variations of engine power and crankshaft rotational speed during the endurance test shall not exceed three per cent of the specified values of power and speed.

(a) Ninety hr at the maximum continuous crankshaft rotational speed and engine power at which the engine is to be rated. If a rating in excess of the maximum

Parts II and III, to be published in early issues of AUTOMOTIVE *and* AVIATION INDUSTRIES, will give Design Standards for Aircraft Structures, Control Systems, Landing Gears and Brakes.



continuous rating is desired for take-off purposes, the last 10 hr of this test shall be conducted at the take-off speed and power at which the engine is to be rated. Instead of this 10 hr test, a 20 hr test may be used to substantiate the rating; this test shall consist of alternate five-min periods of operation at take-off speed and power and operation at idling speed. Satisfactory completion of either of these take-off tests shall make the type eligible for operation at the take-off rating. Further, if the maximum continuous ratings at sea level and altitude differ, half of the running at maximum continuous power shall be carried out at the maximum power obtainable at maximum continuous manifold pressure and maximum continuous crankshaft rotational speed at the critical altitude. Under these conditions, a non-detonating fuel may be used, if such a fuel is required to suppress detonation. At least 50 hr of the portion of this test which is conducted at the maximum continuous speed and power ratings, shall be conducted with the oil-inlet temperature and cylinder-head or coolant-outlet temperature (whichever is applicable) equal to not less than the maximum values to be specified as satisfactory for continuous operation.

(b) A total of 40 hr of operation, consisting of eight hr at each of 50, 60, 65, 70, and 75 per cent of the maximum continuous rated power. The crankshaft rotational speed, engine manifold pressure, and mixture strength shall be appropriate for each value of power output to simulate critical cruising conditions at these powers.

(c) Twenty hr at the maximum weak mixture manifold pressure and maximum weak mixture crankshaft rotational speed, at the most economical mixture strength for which the engine will be declared suitable for operation during the periods of unrestricted duration. This test shall be carried out at the maximum operating temperatures declared by the manufacturer for operation under these conditions.

OPERATION TEST—After the completion of the endurance test, and if such test is necessary, the penalty vibration test, the engine shall be subjected to such tests as may be required to demonstrate satisfactory backfire characteristics, starting, idling, acceleration, overspeeding, functioning of propeller and ignition, and to such other tests as may be prescribed. Certain of these characteristics may be determined during the course of the endurance test.

RECALIBRATION TEST—At the completion of the calibration, detonation, endurance, and operation tests, the engine shall be recalibrated to determine any change in power characteristics caused by these tests. Approved power ratings shall be based on the average power output determined from the calibrations before and after the endurance tests.

Power ratings shall be based upon the following atmospheric conditions: (a) dry air; (b) intake air temperature of 59 F; (c) atmospheric pressure of 29.92 in. Hg. If engine power is affected by deviation of cooling-air temperature from 59 F or of coolant temperature from the specified value, appropriate corrections may be made.

During all of the tests, herein described, only servicing and minor repairs shall be permitted; except that, where deemed acceptable, major repairs or replacement of parts may be resorted to, provided that the parts in question are subjected to additional penalty tests. The extent of these penalty tests shall be dependent upon the nature and extent of the repairs or replacements involved.

Compliance with the foregoing requirements entitles the engine to a certificate of type approval, which will be regarded as establishing its fitness for installation in an airplane. However, before the airplane in which it is installed can be certificated for the particular operation for which it is intended, compliance with the applicable paragraphs of Powerplant Installation, must have been demonstrated, and any prescribed additional flight tests must have been complied with.

Fuel System Tests

Fuel systems shall be so constructed and arranged as to ensure a supply of fuel to each engine at a flow rate and pressure which have been established for satisfactory engine functioning under all normal conditions of operation, including all maneuvers for which the airplane is intended. Compliance with the following tests shall be demonstrated.

FUEL FLOW-RATE TESTS—The fuel system shall be adequate to supply fuel at the required flow-rate and pressure under all engine operating conditions within approved limits, at all attitudes possible in sustained flight, and in the various combinations under which the fuel system can be operated. These tests shall be carried out with a low fuel supply and to an approved schedule. The fuel flow rate for gravity feed systems shall be 150 per cent of the fuel consumption of the engine at maximum take-off power. The fuel flow rate for pump systems shall be 125 per cent of the fuel consumption of the engine at maximum take-off power. This flow rate shall be applicable to both the primary engine-driven pump and to emergency pumps, when either is inoperative, and shall be available at the pump speeds obtainable during take-off operation. In the case of hand-operated pumps, the test speed shall be not more than 60 complete cycles (120 single strokes) per min.

VAPOR-LOCK TEST—Fuel systems shall be so arranged as to minimize the possibility of the formation of vapor locks under all normal conditions of operation. There shall be no evidence of vapor locks, or other malfunctioning, when the airplane is operated with the fuel at a temperature of not less than 110 F, and is climbed at the recommended rate of climb to the altitude at which the one-engine-inoperative best rate of climb, in fpm, is not more than:

$$KV_{s_o}^2$$

where, V_{s_o} the stalling speed, or minimum steady flight speed, calibrated airspeed, with wing flaps in landing position) is expressed in mph, and K has the following values:

Maximum Sea-Level Take-Off Weight, lb	K
40,000 or less	0.02
40,000 to 60,000	$0.02\left(\frac{W-20,000}{20,000}\right)$
60,000 or more	0.04

when climbing at the weight corresponding to operation with full fuel tanks, minimum crew, and only that ballast necessary to maintain the center-of-gravity limits for which the airplane is to be certificated. Compliance with this requirement shall be demonstrated either in flight or by means of a ground installation which closely simulates flight conditions.

FUEL-FEED TESTS WITH LOW FUEL—The unusable fuel supply for each tank shall be the quantity at which the first evidence of malfunctioning occurs under the most adverse conditions, including those specified as follows: (a) level flight at maximum continuous power, or at the power required for level flight at V_c (design cruising speed, equivalent airspeed), whichever is the lesser; (b) climb with wing flaps in take-off position landing gear retracted, engines operating at maximum take-off power, and at maximum landing weight and take-off safety speed; (c) sideslips and skids in level flight, climb, and glide, of a severity likely to be encountered in normal conditions of operation or in turbulent air.

In the case of airplanes equipped with more than one fuel tank, any tank which is not required to supply the engine in all of the conditions prescribed in the following need be investigated only for those flight conditions in which it will be used, and the unusable fuel supply for the tank in question shall then be based on the most critical of those conditions which are found to be applicable. In all such cases, information regarding the conditions under which the full amount of usable fuel in the tank can safely be used shall be made available to the appropriate members of the flight crew by means of a suitable placard, or by instructions in the airplane flight manual.

If an engine can be supplied with fuel from more than one tank, and engine malfunctioning becomes apparent due to the depletion of the fuel supply in any tank from which the engine can be fed, it shall be possible to regain full power and the required fuel pressure in that engine within 20 sec after switching to any full tank. Compliance with this requirement shall be demonstrated in level flight.

TESTS FOR FLOW BETWEEN INTERCONNECTED TANKS—In the case of systems with tanks whose outlets are interconnected, it shall not be possible for fuel to flow between tanks in quantities sufficient to cause an overflow of fuel from the tank vent, when the airplane is operated as prescribed for fuel feed tests with low fuel, but with the tanks full.

FUEL TANK STRENGTH—Fuel tanks shall have sufficient strength to withstand the following tests without failure or leakage. Pressures applied may simulate the actual pressure distribution in service. (a) For conventional metal tanks, and for non-metal tanks whose walls are not supported by the airplane structure: a pressure of 3.0 psi, or the pressure developed during the maximum ultimate acceleration of the airplane with a full tank, whichever is greater. (b) For other types of tanks: the simultaneous application of the critical combination of: internal pressure developed during the maximum acceleration of the airplane with full tanks, and the corresponding ultimate structural loads. (c) For pressurized tanks: the pressures prescribed in the foregoing tests, increased by the design working pressure. (d) For tanks incorporating large unsupported or unstiffened, flat areas: a suitable combined vibration and slosh test. (e) For tanks with non-metal liners: a suitable slosh test with fuel at appropriate temperatures.

Powerplant Cooling System Tests

The powerplant cooling system shall be capable of maintaining the temperatures of all major powerplant components, engine fluids, mixture, or carburetor intake air, within the established safe values, under all conditions of ground and flight operation.

Compliance with the requirements of cooling shall be demonstrated under critical ground, water and flight operating conditions. If the tests are conducted under atmospheric temperatures deviating from the maximum anticipated air temperatures, the recorded powerplant temperatures shall be corrected in accordance with the requirements of cylinder-head and barrel, coolant, oil-inlet, mixture or carburetor air-inlet temperature corrections. The corrected temperatures determined in this manner shall not exceed the maximum, or fall below the minimum, established safe values. The fuel used during the cooling tests shall be of the minimum octane rating approved for the engine and the operating conditions involved, and the mixture settings shall be those normally employed in the said operating conditions.

MAXIMUM ANTICIPATED AIR TEMPERATURES—The maximum anticipated sea-level intercontinental air temperature shall be assumed to be 100 F. This temperature shall be assumed to decrease at the rate of 3.6 F per 1000 ft of altitude above sea level, until a minimum permissible temperature of -67 F is reached. In the case of airplanes whose operations will be confined to localities where maximum temperatures of moderate intensity will not be exceeded, the maximum anticipated sea-level air temperature may be assumed to be 85 F. In this case, the rate of temperature decrease above sea level may be assumed to be 3.6 F per 1000 ft, until a minimum permissible temperature of -40 F is reached. If the powerplant temperatures are corrected to this limit, this shall be so stated in the airplane flight manual, and the airplane shall be limited to operation under these conditions. In the case of airplanes intended for extreme tropical operation, the higher temperatures to which corrections have been made shall be stated in the airplane flight manual.

CYLINDER-HEAD AND BARREL, COOLANT, OIL-INLET, MIXTURE OF CARBURETOR AIR-INLET TEMPERATURE CORRECTIONS — These temperatures shall be corrected by adding to them the difference between the maximum anticipated air temperatures and the temperature of the ambient air at the time of recording during the cooling test. A correction factor of 1.0 shall be employed unless some other factor can be justified.

LIQUID-COOLANT SYSTEMS—Each liquid-cooled engine shall be provided with an independent cooling system. The cooling system shall be so arranged that no air or vapor can be trapped in any portion of the system, other than the expansion tank, either dur-

(*Turn to page* 90, *please*)

Direct Resistance Heating

BECAUSE the use of 24S-T dimpling tools on 75S-T aluminum alloy, with very few exceptions, results in cracked dimples, an effort was made to devise methods and equipment which could successfully employ heat in making dimples in 75S-T sheet. The direct resistance method developed by the University of California, having been accepted as the method to be used for stationary equipment, underwent further development and research at the Northrop Plant to perfect it for production use. For economy and maintenance this process has met with little expense. Since the initial capital investment of the machine and a few minor developments, maintenance costs have amounted to no more than on any other machine that has mechanical parts that wear out. Figs. 1 and 2 illustrate the machine and its equipment.

In the schematic diagram (Fig. 3), the source of current for resistance dimpling is an 18 kva spotweld transformer. A 10 kva transformer is capable of supplying enough heat for dimpling thicknesses up to and including 0.064 in. The transformer has a combination of 16 settings. It gives a current output ranging from 2000 to 5000

Fig. 2 — Resistance heating electrodes and dimpling tools.

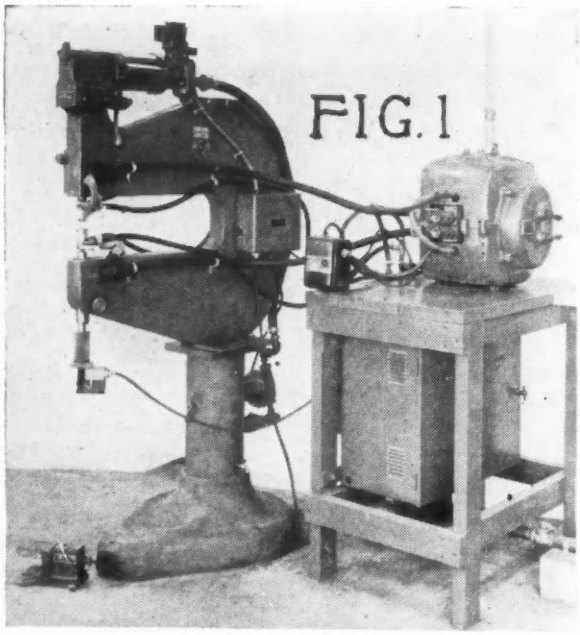


Fig. 1—Resistance heating dimpling equipment setup.

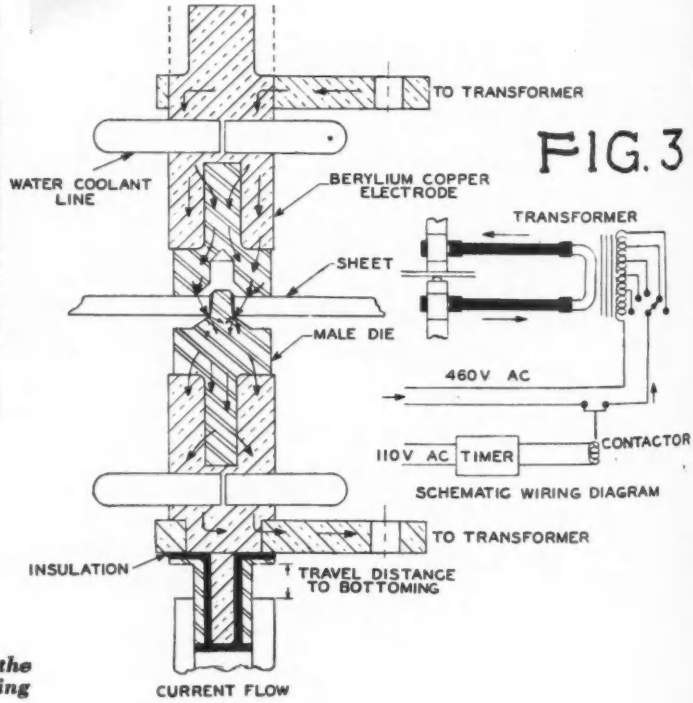


Fig. 3—Schematic drawing illustrating the flow of current in the resistance heating dimple tool.

Method of Hot Dimpling 75S-T

amp. The open circuit voltage of the primary transformer ranges up to six volts. This large amount of current is carried to the electrode holders through heavy bus bars. The electrodes are made of Mallory No. 100 and are water cooled by means of 3/8 in. holes drilled through the sides of the electrodes. The dimple punch and die which are seated in the electrodes are made of hardened tool steel and have a dimple geometry which gives a sharp, well-defined dimple. The electrode holder is raised 3/8 in. above the bottom ledge by means of a steel coil spring (7). (See Fig. 4).

It requires approximately 85 lb pressure to depress the holder spring to the point where it forces the actuating arm (9) to trip the micro switch (5). The pressure can be varied by turning the nob (6) causing the cam (8) to move the plate (4) on which the micro switch (5) is mounted. By increasing or decreasing the distance between the rocker arm (9) and the micro switch (5) the amount of spring pressure can be varied. This makes it possible to accurately adjust the spring to prevent arcing before sufficient contact pressure has been reached. The micro switch sets off the electronic timer which closes the circuit from the power supply to the transformer. The electronic timer may be set to permit current to travel through the circuit for a period of 0.05 sec to 1.0 sec. The compression squeeze machine employed is a Chicago Pneumatic 450 E.A.

To illustrate the operation, assume that the timer is set at 0.1 sec and the transformer at 1-1. The machine operating switch is closed. Air pressure is developed which brings the ram and the top electrode down, forcing the die into close contact with the drilled sheet resting on the male punch. The die and punch in joint contact with the metal sheet travel down until the lower electrode reaches the bottom ledge. During this travel the rocker arm (9), Fig. 4, trips the micro switch which causes the timer to initiate the current flow to the transformer. The current flows 0.1 sec before the circuit is opened. The metal is heated before the

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Chief Process Engineer

and Al Schoellerman,
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Northrop Aircraft, Inc.

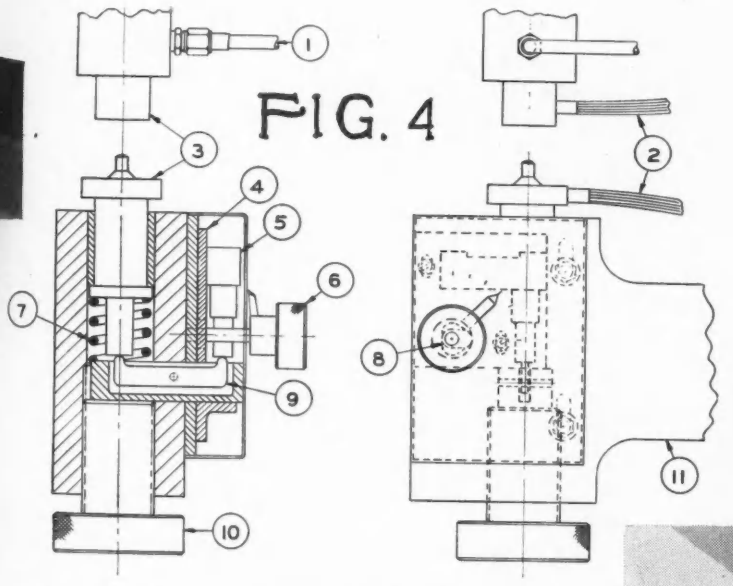

FIG. 4

Fig. 4—Spring loading mechanism for initiating the current flow through the transformer.

Table I—Specimen Data for Various Size Rivets

Rivet size, in.	3/32	1/8	5/32	3/16	1/4
Specimen width in.	1/2	1/2	5/8	3/4	7/8
Drill size	40	30	21	12	F

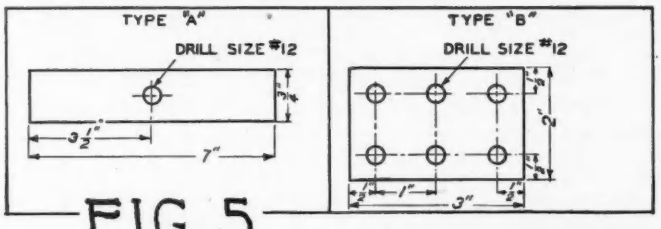

FIG. 5

Fig. 5—Control test specimens for 3/16 in. dimple; 0.051 material thickness.

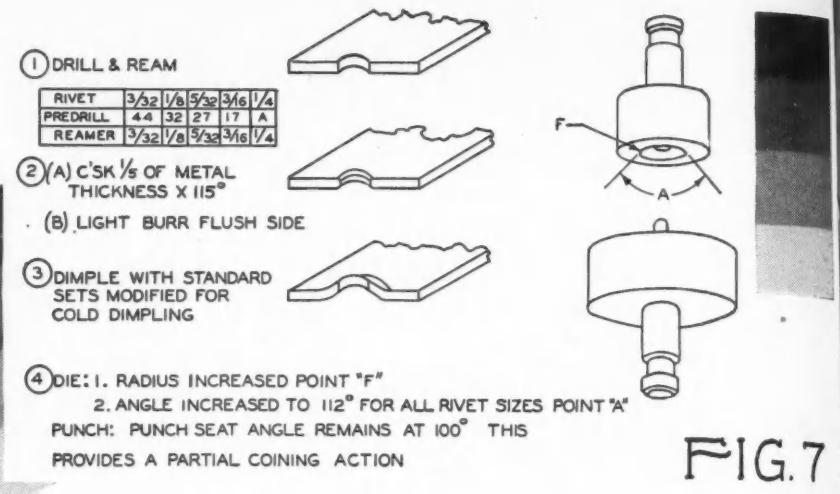

FIG. 7

Fig. 7—Cold dimple procedure used on parts not accessible to the stationary equipment.

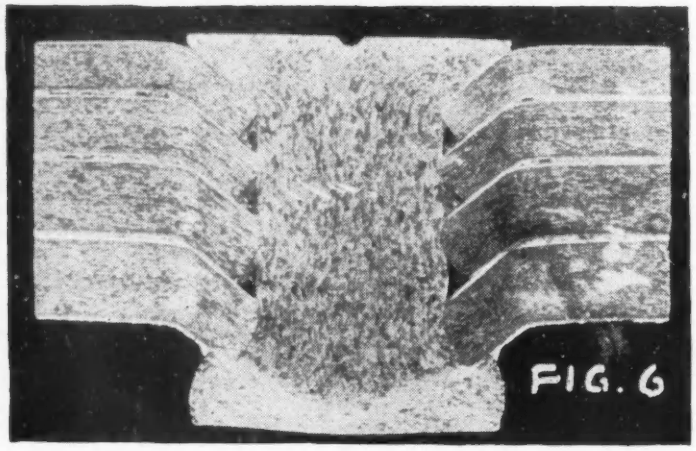

FIG. 6

Fig. 6—Cross-section of dimples and rivets illustrating rivet definition and flushness.

.040 75S-T Resistance Heated Dimple
.051 75S-T Resistance Heated Dimple
.064 75S-T Resistance Heated Dimple
.072 75S-T Resistance Heated Dimple

lower electrode reaches the bottom. When the lower electrode reaches bottom the ductile hot metal is shaped between the punch and die.

The current first passes through the edge of the hole, then radially through the surrounding area (see Fig. 3). Thus, the temperature is greatest where the severest forming occurs. This local and rapid heating makes it possible to use higher forming temperatures and also prevents warpage caused from the heating. The use of intercooling cools the metal so rapidly there is no working hazard caused by the high temperatures used in the forming operation. Also, little warpage or distortion is caused by the heat.

It is of the utmost importance that the forming action be timed to permit good contact before the current flows and to permit the current to flow before the forming of the dimple occurs. If the current flows before good contact is made, arcing of the metal and tool results. If the current travels after the dimple is partly or fully formed, it will arrive after the damage (caused from cold forming) is done.

Qualifying a machine for production use has been accomplished through the use of two control specimens (see Fig. 5). The use of the type A specimen is to control the amount of heat used. By pulling this specimen in a calibrated tensile machine it is possible to control the actual tensile strength of the material. Thus, if too much heat is used the psi will drop showing an annealed dimpled area. This specimen is unusually effective in detecting any malfunctions of the machine toward overheating. Table I gives the widths of specimens for the different rivet sizes.

Type B specimen is used to control various other items such as warpage, dimple flushness, die marks, and cracks. Warpage is qualified to mean that caused by too little or excessive pressure. Cracks are determined both visually on production and internally on original machine certification and weekly thereafter.

In establishing the original certification the type A specimen is used to seek out the correct heat by the following means:

1. Several drilled specimens are pulled to get a rough value on what the actual load of the specimen is before dimpling.

2. An arbitrary machine setting is chosen and several dimpled specimens are made. These specimens are then pulled to determine which direction to go thereafter. If the specimen pulls short of the undimpled specimens, it is obvious too much heat has been applied. If the specimen pulls above, too little heat has been applied and the dimpling operation has work hardened the metal.

3. After a setting has been found that will approximate the undimpled specimens, the current is increased slightly to the point where the specimen starts to show annealing, making sure that the psi doesn't fall below the minimum allowable for 75S-T.

4. Thirty specimens are made with the machine

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Airbriefs

By Robert McLarren

Long Distance Flight

The AAF has completed preparations for the longest non-stop aircraft flight ever made—10,300 miles from Honolulu to Cairo over the North Pole. The Boeing B-29 "Pacusan Dreamboat" will be piloted by Col. C. S. Irvine, who holds the present record of 8198 miles. A total of 13,000 gallons will be required for the flight, which will fall over Point Barrow, Alaska (where Will Rogers and Wiley Post met their death in 1935) and London en route. Object of the flight is to establish operating techniques for its two new 10,000-mile-range strategic bombers, the Northrop XB-35 and the Consolidated Vultee XB-36. The flight over the North Pole is significant.

Speed Record

Both England and America are hard at work contesting for the world's aircraft speed record and over it hangs the shadow of the Bell XS-1, which promises to fly at the speed of sound and beyond. The present record is 606* mph set by RAF Group Captain Hugh Wilson in a Gloster Meteor on November 7, 1945. The AAF has made repeated but unsuccessful attempts to match this record in a Lockheed XP-80B Shooting Star, especially designed for racing purposes. On August 31 the AAF succeeded in attaining a speed of 608 mph in a Republic XP-84 Thunderjet at Muroc Army Air Base, Calif. However, this failed to better the previous mark by the required 5 mph.

A special "clipped-wing" Gloster Meteor, of the RAF's unique High Speed Squadron, recently attained a speed of 626 mph over the new course at Tangemere, but the run was an unofficial tryout of the new plane. The Bell XS-1 is scheduled to make its first test flight this fall, although the unfortunate death of Jack Woolams, Bell test pilot scheduled to make the flights, will require training a new pilot for the job. A speed of 1000 mph is confidently predicted. In the meantime, the Federation Aeronautique International, world governing body of aviation contests, met in London Sept. 10 in its first postwar meeting to consider numerous changes in its requirements dictated by radically new aircraft, higher speeds, altitudes and load-carrying marks.

* On Sept. 7 a twin-jet engined Meteor IV set a new world airplane speed record by flying 616 mph in England—Ed.

Parasite Fighter

The AAF has revealed plans for a tiny fighter plane, which will be carried within the spacious bomb-bays of the giant Consolidated Vultee XB-36 bomber and launched high in the air. The fighter is the McDonnell XP-85 powered by a Westinghouse 24C axial-flow turbojet unit. The tiny fighter will have a top speed of over 600 mph and a phenomenal rate-of-climb.

Bendix Helicopter

Following a year of secret test flights and extensive development work, Bendix has announced plans for the production and marketing of its radical helicopter, which features counter-rotating blades on a single vertical shaft above the cabin. The design will be manufactured in a new 100,000 sq ft plant now under construction at Stratford, Conn. Four-place versions are already under construction and Bendix hopes to attain a production rate of 200 a month by early next year. The Model J is powered by a Pratt & Whitney Wasp Junior of 450 hp.

Aircraft Pay

Recent statistics reveal that the aircraft worker of today is making virtually the same as he did during the war, although working far fewer hours overtime. Average hourly wage is now $1.26 as compared to $1.20 one year ago. "Take home" pay is now $51.41 per week as compared to $55.61 a year ago. However, the average workweek is now 12 per cent shorter than a year ago.

Giant Transport

The Navy has revealed that its largest transport landplane, the 92-ton Lockheed Constitution (XR60-1), will be placed in service over Naval Air Transport Service routes in this country prior to overseas assignment. The giant craft is powered by four Pratt & Whitney R-4360 Wasp Major engines developing more than 12,000 hp total. The craft has a span of 189 ft and is 156 ft long. Following completion of two reciprocating engine versions for the Navy, Lockheed has announced plans for a gas turbine-powered commercial version.

Supersonic Wind Tunnel

The Navy has completed plans and construction has begun on its $15,000,000 research center for ordnance materiel at White Oak, Md., near Washington, D. C. The center will include the captured German supersonic wind tunnel which was dismantled at the V-2 experimental station in Bavaria and brought to this country. The Army Air Forces are also surveying several sites for erection of a similar captured supersonic wind tunnel.

Stagnation Temperature

High speed flight has already provided an indication of a severe problem to come—friction heating of high speed aircraft and missiles. The AAF reports that the temperature inside the Lockheed P-80 Shooting Star at a speed of 500 mph is 60 F. warmer than the outside air due to the friction generated on the fuselage skin by the air. The Nazis encountered this problem in an even more extreme form with their V-2 and solved it by installing four inches of glass-wool insulation around the nose containing the warhead. As the speed of sound is approached, this heat problem becomes severe and engineers point to it as the critical factor in the design of supersonic aircraft. First step is a shift from aluminum to steel construction for supersonic designs and studies of various refrigerating systems are well advanced.

Hoppicopter

Aviation circles received with good humor the announcement a year ago of the Pentecost Hoppicopter, a shoulder-harness arrangement containing a small engine and helicopter blades capable of lifting and flying a 200-lb man. The device was the work of Horace T. Pentecost, of Seattle, Wash. However, Pentecost has continued development of the idea and is planning quantity production of the device which he will sell at "less than $1000." The device has been redesigned and a frame included in which the operator sits. Successful test flights of the device have been made. It is powered by a 35-hp Righter engine, which rotates a 15 ft rotor. It will have a top speed of 90 mph and a 12,000 ft ceiling. Pentecost believes the Hoppicopter will

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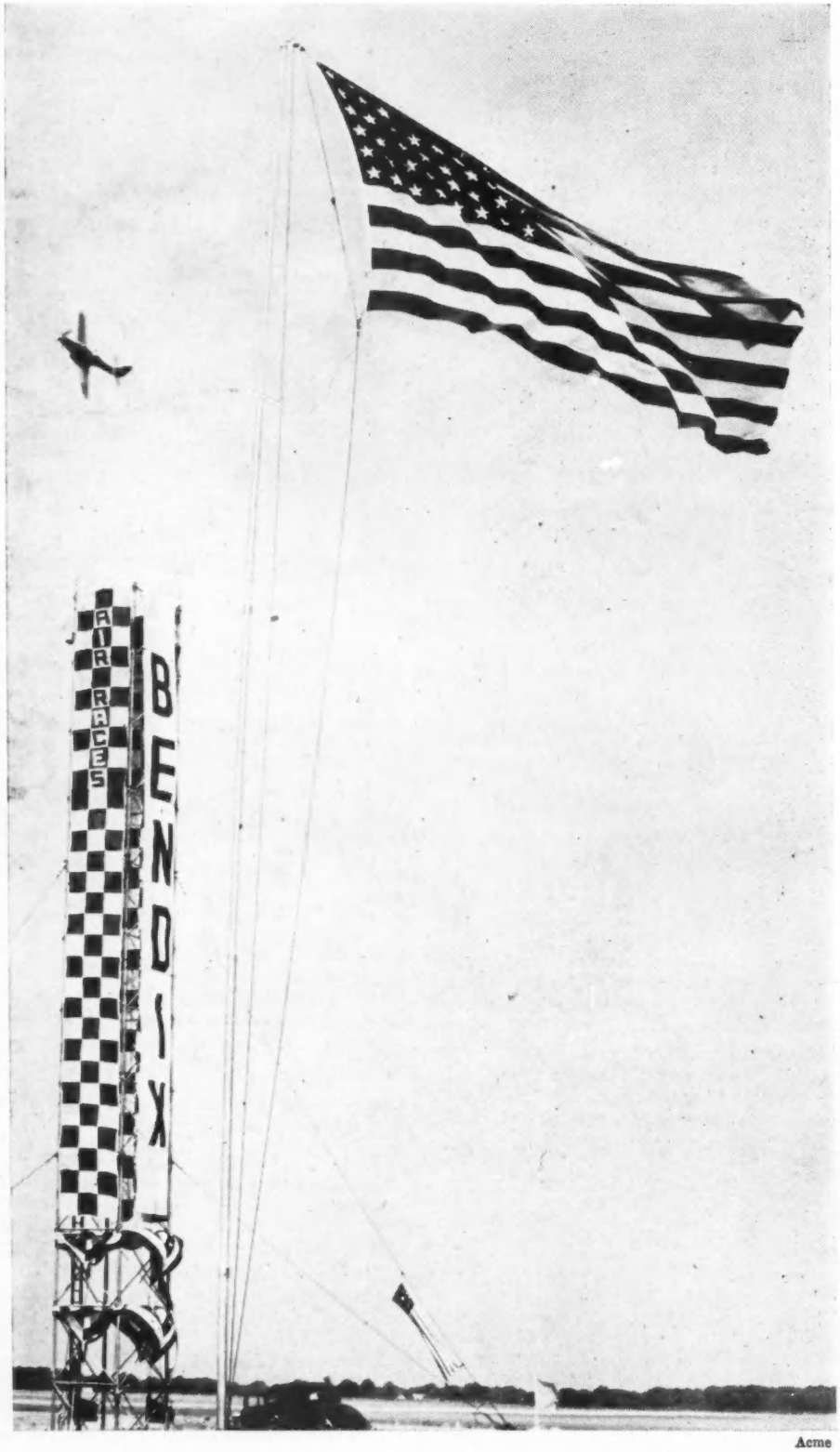
World War Fighter Planes Vie at

National



Acme

THE first postwar National Air Races at Cleveland Aug. 30-Sept. 2 saw in competition most of the fastest conventional-powered fighter planes of World War II in the money events, but the biggest show was put on by the AAF's Lockheed P-80 Shooting Stars, powered with G-E Allison I-40 jet engines.

For any who still doubt the superiority of jet planes for speed, the performance of the Shooting Stars in "J" divisions (jet engine) of the Bendix cross-country and Thompson closed course races must have clinched the argument. Major Gus Lundquist, Wright Field P-80 pilot, whistled around the Thompson 30-mile triangular closed course for a seven-lap average of 515.855 mph while Alvin Johnston, Bell test pilot, who won the $16,000 first prize in the "R" (Reciprocating engine) division of the Thompson Race of 10 laps over the same course, averaged 373.908 mph. Correspondingly Col. Leon Gray, March Field P-80 pilot, flew the Bendix course from the Aviation Maintenance Corporation's base at Metropolitan airport, Van Nuys, Calif., to Cleveland (2048.55 miles) at an average speed of 494.779 mph while Paul Mantz, Burbank, Calif., first money winner in the Bendix "R" division, had an average of 435.501 mph.

The I-40 engines of the

By Alec Walker

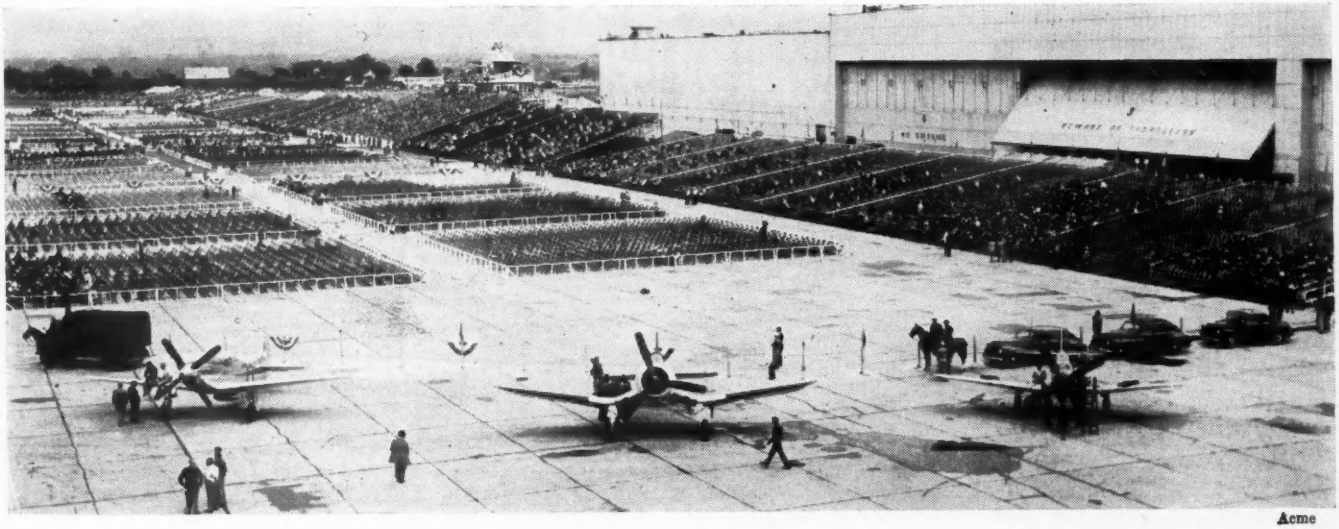
Air Races

Shooting Stars are rated at 4000 thrust-pounds, which is the equivalent of 5000 hp at a speed of 470 mph. The jet planes were described by the AAF as tactical planes carrying full armament, and not "doctored" for the races, except for extremely glossy-smooth waxed finishes which added appreciably to their aerodynamic cleanliness and speed.

Johnston's winning plane in the Thompson race, Cobra II, was probably the best example of conversion of a fighter aircraft to closed course racer at Cleveland. The plane, owned by Skylanes, Unlimited, an organization of Bell employes, was originally a P-39-Q-25 Airacobra, one of the last of the P-39s built, and which was virtually brand-new when Johnston got it. The primary modification of the plane after removal of cannon, machine guns, armor plate, bomb racks, radio, oxygen equipment and other excess weight items, was the replacement of the single-stage supercharger Allison V-1710 E-4 engine, rated at 1100 hp for takeoff, with a later and more powerful two-stage engine, the V-1710 E-30, the type used in the P-63 Bell Kingcobra. This was rated at 1700 hp and with water-alcohol injection it was reported that Johnston was getting between 1900 and 2000 hp from it. The larger engine used a four-bladed Aeroproducts propeller, designed for the P-63 instead of the three-blader used on the stock P-39. It was understood that Johnston was pulling between 85 and 90 in. of manifold pressure for maximum power. His plane was first in the air in an incredibly short takeoff, and was never headed in the race. His speed of 373.908 mph set a new record, exceeding the record speed of 283.419 mph made by Roscoe Turner in 1938.

Johnston's plane was a sister ship to the Cobra I, entered by Bell's chief test pilot, Jack Woolams, which qualified with a high speed, but which crashed Aug. 30 into Lake Ontario during a test flight, resulting in Woolams' death. After the Woolams crash, mechanics and engineers hurriedly "beefed up" the section of the Cobra II's fuselage containing the "buried" engine behind the pilot, and on rearward to the tail. This was done by riveting strips of Alclad lengthwise along the fuselage to provide additional strength. An eyewitness had reported that Woolams' plane had broken in two just behind the "buried" engine, so that he lost the entire empennage. The external reinforcements apparently solved the problem for Johnston.

The No. 2 plane in the Thompson race, Tony LeVier's Lockheed Lightning P-38, powered by two Allison V-1710 engines, gave the best exhibition of stamina since the same plane was used by LeVier in daily high speed stunt flying exhibitions at the races. Like the Bell plane, it was one of the last of its type built and was virtually new when LeVier took it over. While not officially sponsored by their parent companies the planes of Johnston and LeVier obviously had the blessings of the top Bell and Lockheed officials, and were groomed by large crews of factory



Acme

Bendix Trophy Race Winners

(Los Angeles to Cleveland)

Year	Pilot	Plane	Engine	Time	Avg. Speed (mph)
1946*	Mantz	North American P-51	Packard, Rolls-Royce	4:42:10	435.501
1946**	Col. Gray	Lockheed P-80	G-E Allison I-40	4:08:03	494.779
1939	Fuller	Seversky	Twin Wasp	7:14:19	282.098
1938	Cochran	Seversky	Twin Wasp	8:10:31.4	249.774
1937	Fuller	Seversky	Twin Wasp	7:54:26.3	258.0
1936	Thaden	Beechcraft	Whirlwind	.....	.....
1935	Howard	Howard	Wasp	8:33:16.3	238.70
1934	Davis	Wedell-Williams	Wasp Jr.	9:26:41	216.24
1933	Turner	Wedell-Williams	Wasp	.....	.....
1932	Haizlip	Wedell-Williams	Wasp Jr.	8:19:45	245.0
1931	Doolittle	Laird	Wasp Jr.	9:10:21	223.06

*—R-Division for reciprocating engine airplanes (Bendix Trophy winner).
**—J-Division for U. S. Military jet airplanes.

technicians for the race. Both planes were highly wax-polished like the P-80s, for further reduction of drag.

Two other interesting fighter modifications at Cleveland were the P-63 Kingcobras flown by Major Charles Tucker, of La Crescenta, Calif., former CBI fighter pilot, in the Bendix and the Thompson races. Tucker placed seventh in the Bendix, with a Kingcobra which had normal wingspan, and had wingtip fuel tanks, of the type used on the Lockheed P-80 Shooting Star. These tanks were faired to the wingtips as integral parts of the wing structure and were not droppable. Placed at the tips they do not disturb the airflow around the main section of the P-63's laminar flow type wings, as do tanks carried farther inboard on the wings or under the fuselage. Although virtually all of the Bendix racers carried external auxiliary tanks, Tucker was the only one to use the wingtip version.

In the Thompson race he entered another P-63 with only a 25-ft wingspan. He had modified this plane by clipping 6½ ft from the tip of each wing. The plane did not use flaps on its abbreviated wings, and landed at a speed of 140 mph, according to Tucker. Other estimates of the landing speed ran as high as 170 mph. Tucker previously had qualified this plane for the Thompson at a speed of 392.584 mph but when his landing gear retracting mechanism failed and he couldn't get his wheels up, he quit the race without finishing the first lap and landed the plane. On this plane Tucker also had the largest tank for water-alcohol injection, carrying 108 gallons of the cylinder injection fluid. Tucker's planes were notable in that he and his father and a couple of mechanics had done all of the modification, according to their own plans and engineering, without outside aid.

North American P-51 Mustangs, powered by Packard Rolls-Royce liquid-cooled engines (1649 cu in.) took the first four places in the Bendix race, the first two places in the Sohio closed course race for planes which failed to qualify in the Thompson eliminations, and placed third, fourth, fifth and seventh in the Thompson race. Liquid-cooled Allison engines powered the first and second place planes in the Thompson race.

Jacqueline Cochran (Mrs. Floyd Odlum), 1938 Bendix race winner, who placed second in the 1946 Bendix, flew a Mustang which reportedly had been rebuilt for her as a racing plane by North American technicians.

Quickest modification job was that of Robert A. Swanson, Cleveland pilot, who crashed one Mustang in a Thompson qualification trial, walked away from the wreckage and bought another P-51 by long distance telephone. The plane arrived in Cleveland Saturday, was stripped down and qualified Sunday, and placed fifth in the race Monday. He obviously did little more than remove the excess weight items, and tune the engine.

Conspicuous by its absence was the Republic P-47 Thunderbolt, the only major American fighter of World War II not in any of the races. As a result, the only aircooled engine-powered entries in major races were two Corsairs and a Douglas A-26 Invader. The Corsairs were both FG-1 models built by Goodyear

Thompson Trophy Race Winners

Year	Pilot	Plane	Engine	Avg. Speed (mph)
1946*	Johnston	Bell P-39	Allison V-1710	373.908
1946**	Maj. Lundquist	Lockheed P-8	G-E Allison I-40	515.855
1939	Turner	Turner-Laird Special	P & W Twin Wasp Sr.	282.53
1938	Turner	Turner-Laird Special	P & W Twin Wasp Sr.	283.41
1937	Kling	Folkerts Special	Menasco 6-cyl in-line	256.91
1936	Detroyat (France)	Caudron-Renault	Renault 6-cyl in-line	264.26
1935	Neumann	Howard Racer	P & W Wasp	220.19
1934	Turner	Wedell-Williams Special	P & W Hornet	248.12
1933	Wedell	Wedell-Williams Special	P & W Wasp Jr.	237.95
1932	Doolittle	Gee Bee Supersportser	P & W Wasp Sr.	252.68
1931	Bayles	Gee Bee Supersportser	P & W Wasp Jr.	236.23
1930	Holman	Laird Solution	P & W Wasp Jr.	201.90

*—R-Division for reciprocating engine airplanes (Thompson Trophy winner).
**—J-Division for U. S. Military jet airplanes.

1946 National Air Race Winners

Race	Pilot	Plane	Engine	Speed(mph)
Thompson*(R)	Alvin Johnston	Bell P-39	Allison V-1710	373.908
Thompson**(J)	Maj. Gus Lundquist	Lockheed P-80	G-E Allison I-40	515.855
Bendix[x](R)	Paul Mantz	North American P-51	Packard Rolls-Royce	435.501
Bendix[x](J)	Col. Leon Gray	Lockheed P-80	G-E Allison I-40	494.779
Weatherhead Jet Dashes[y]	Lt. W. J. Reilly	Lockheed P-80	G-E Allison I-40	578.36
SOHIO[z]	Dale Fulton	North American P-51	Packard Rolls-Royce	352.781
Halle[t]	Margaret Hurlbert	North American AT-6	Pratt & Whitney Wasp	200.588

(R)—R-Division for reciprocating engine airplanes.
(J)—J-Division for U. S. Military jet airplanes.
*—300 miles. **—210 miles .
[x]—Van Nuys, Calif., to Cleveland.
[y]—Two passes over one-mile course.
[z]—240 miles. [t]—75 miles.

Aircraft division from the Chance-Vought F4U design, and powered by Pratt & Whitney 2000 hp, 2800 cu in. displacement engines. One finished 15th in the Bendix while the other finished sixth in the Thompson race. The lone A-26 entry, powered with two Pratt & Whitney R-2800 engines, finished sixth in the Bendix.

Five women flyers in the first running of the Halle women's race, all used the North American Texan advanced trainer, with 550 hp Pratt & Whitney Wasp engines. Four of the planes were the Army version (AT-6) with one Navy SNJ-3 entered.

Army Air Force and Navy exhibitions at the races showed a number of interesting aircraft, the largest of which was the Douglas C-74 Globemaster four-engine transport (span, 173 ft; length, 124 ft), which demonstrated its ability to back up and maneuver with surprising agility while taxiing because of its reversible pitch Curtiss propellers.

The only Navy jet plane displayed was the Ryan Fireball fighter which has a 1200 hp Wright air-cooled engine in the nose and a General Electric I-16 turbo-jet engine in the tail. The plane's best trick in the repertory displayed was flying low in front of the grandstand with its conventional propeller feathered, while the jet engine in the tail continued to supply thrust for flight.

Other service aircraft displayed in flight included formations of Boeing B-29's Wright-powered; Douglas A-26 Invaders, Pratt & Whitney powered; Grumman F-8-F and F-7-F's; Chance-Vought Corsairs; Republic P-47 Thunderbolts; North American P-51 Mustangs; and a solitary Fairchild C-82 cargo plane which demonstrated surprisingly good single-engine performance with the second engine feathered.

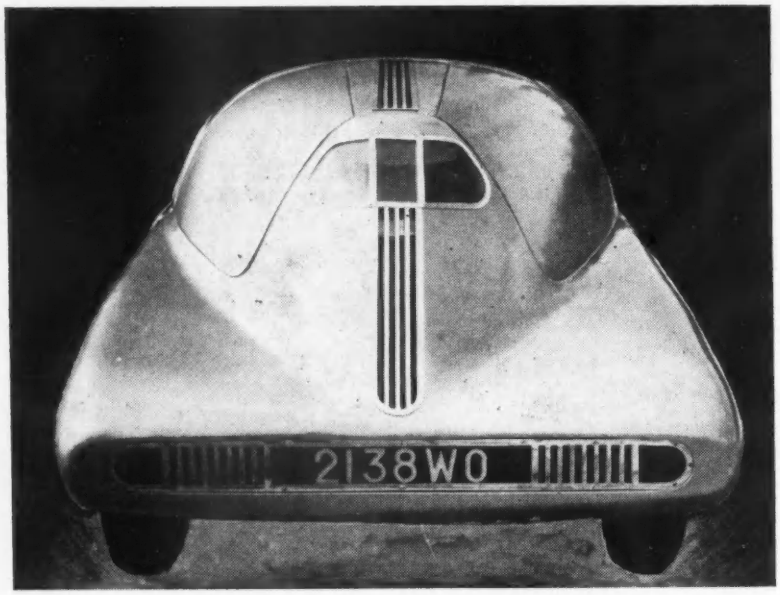
Oddest aircraft on the field was the aged stunt plane of Mike Murphy, retiring undefeated acrobatic champion. The plane is a German Bucker Jungmeister biplane with swept back wings, and with engine converted for inverted flight. It was brought to this country in the late 1930's by Alex Papana, Roumanian flyer, who sold it to Murphy. It had been hangared throughout Murphy's wartime service as Wright Field test pilot and glider combat pilot, and he rebuilt it for the Cleveland show. He sold it to Beverly Howard, Orangeburg, S. C., another stunt flyer, and announced his retirement. Howard had another unconventional plane, doing precision acrobatics at the show, a Piper Cub Special with 90 hp engine, and clipped wings.

A personal plane daily "fly-past" exhibited the performance of the four-place Republic Seabee amphibian (215 hp Franklin engine), the 150 hp Franklin-powered Stinson Voyager 150, also four-place; the three-place 100 hp (Lycoming-powered) Piper Super-Cruiser, and the four-place 185 hp (Continental engine) North American Navion. The Seabee stole the personal plane spotlight by running daily shuttle service from the dock on the downtown lakefront to the Cleveland airport arena for the show. It too boasted a reversible pitch propeller (Hartzell) which enabled it to back up while taxiing, either on water or land.

Used Car Dealers to Form Association

Representatives of used car dealers throughout the country will meet in Chicago Sept. 24 to organize the National Used Car Dealers Association. At an initial meeting held in Detroit in August and attended by 200 dealers, the ground work was laid and a temporary executive committee appointed to work out procedures.

The used car dealers are reported to be thinking of the national organization patterned largely after the NADA. However, it also is considering setting up its own industry advisory committee to deal with OPA. Decontrol of used cars is the first major objective of the group, but the organization also is being formed as a permanent association to further the interests of the used car dealers. Present thinking is that late model cars should remain under control to prevent a buyer from purchasing a new car at ceiling price and then later selling it at a higher figure. One speaker stated that there are two used car dealers for every new car outlet.



This view shows the air inlet and discharge passages for the rear-mounted engine.

The

SPEED champion of France, Jean Pierre Wimille has produced a car to his own general design, in collaboration with engineer Viel. A clover leaf three-passenger sedan, the car has a rear engine, rear wheel drive, independent suspension all-round and a penetration coefficient, according to wind tunnel tests on a model, of 0.25.

Although there is a limited use of light alloys, total weight has been kept down to 1760 lb, Wimille's ideal being 2200 lb, fully loaded. Chassis rigidity has been secured by the use of two large diameter steel tubes, 18 in. between centers, forming the main frame members. These two tubes carry the power plant and receive the suspension elements. To secure the necessary width for the body, the inside dimension, being 58 in., outriggers are welded to the two main tubes, the space between being filled in to form the floor. The aluminum body is welded to the chassis, but does not add to its rigidity.

For a sport model Wimille considers three seats are sufficient. He has placed the driver's seat in the center, with the two passengers' seats slightly to the rear. This gives full elbow room for the driver. While there is a gap between them, the two passengers are practically side by side.

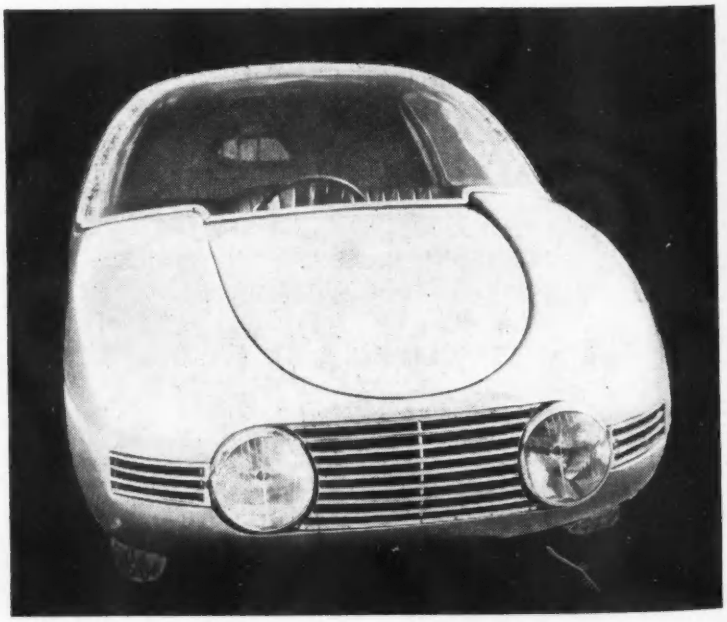
Exceptional visibility is secured by the use of a Plexiglas windshield, rounding into the roof and also rearward at the sides. As the driver is just ahead of the door posts, lateral visibility is good, and by reason of the curvature of the windshield into the roof there is a view in a vertical direction.

The radiator is mounted in front, under a rear-hinged hood; the battery is housed in this compartment, and the spare wheel is carried horizontally. Connection from the radiator to the engine is by means of tubing, mounted inside the chassis tubes. Air is admitted to the radiator through the grille in the entering edge of the airfoil body, at a point where pressure is at its maximum, and is discharged at a point of low pressure on the underside. For normal use a fan is not required, but a thermostically controlled ventilator is provided to come into action for slow running in traffic or when the car is standing still.

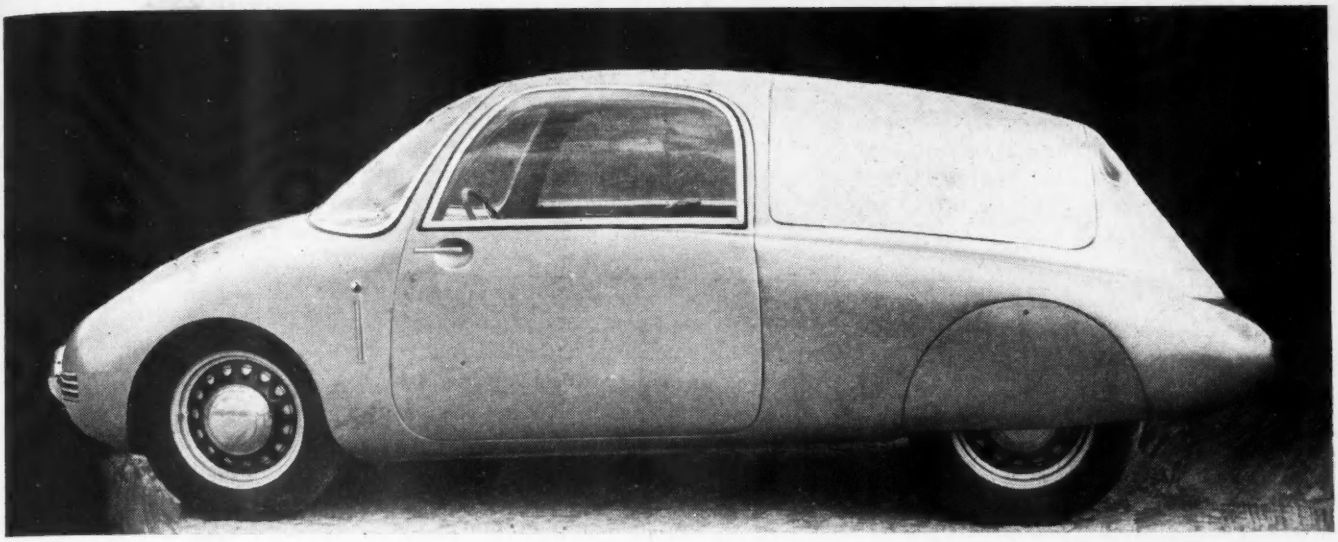
A bulkhead separates the passenger compartment from the engine room. As the height of the engine is low, there is a platform above it for baggage, access to this being either from the interior or by opening the rear hood. There are no externals; even the muffler is mounted across the rear of the frame inside the body.

The engine adopted for this car is a six-cylinder 120 deg. V. This gives a reduced overall height and allows room for the baggage platform already mentioned, while the increase in width is no disadvantage in a car having uniform body width from end to end.

While steel is used in the chassis construction, light alloys are found in the engine. The cylinder block is aluminum alloy with cylinder liners, and the heads are aluminum with valve seat inserts. Cylinder dimensions are 2.835 in. bore with a stroke of 2.441 in., giving a piston displacement of 92.4 cu. in. The valves



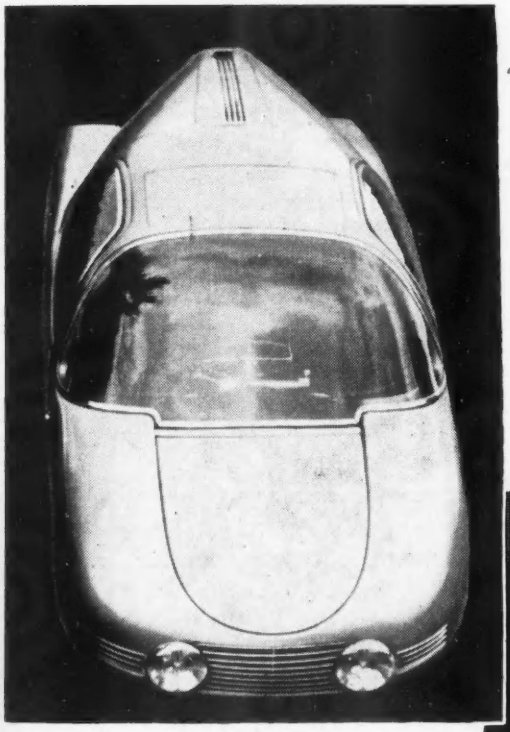
The front wheels of this French design are completely enclosed within the body panels.



Wimille *A New High Performance French V-6 Car*

By W. F. Bradley

Special Correspondent of AUTOMOTIVE *and* AVIATION INDUSTRIES in France



(Above) High front view of the Wimille car. Note the curved windshield and side windows.

are inclined in the head and operated by rockers and short pushrods from high-placed camshafts.

Three types of engine are provided, with 80 per cent of the parts being interchangeable. The standard engine has coil valve springs, develops 80 hp, and peakes at 5000 rpm. A high-speed model has torsion bar springs and develops 110 hp, while the third type, also with torsion bar springs, is supercharged with a Rootes type blower and develops 200 hp, with special fuel, at 7000 rpm. Chassis and body are identical for the three types.

The lubrication system is the dry sump type, the oil being first led to the rear plain bearing and through the shaft to the three roller bearings. Rollers are used for the connecting rod bearings. The rods are I-section steel. It is claimed that the weight of the engine is 132 lb and of the entire power plant 264 lb. Among the features of the engine may be mentioned the recessing of the cylinder barrels into the head, with the

(*Turn to page* 88, *please*)

Unusual seat arrangement of the Wimille car. The driver occupies the center seat.

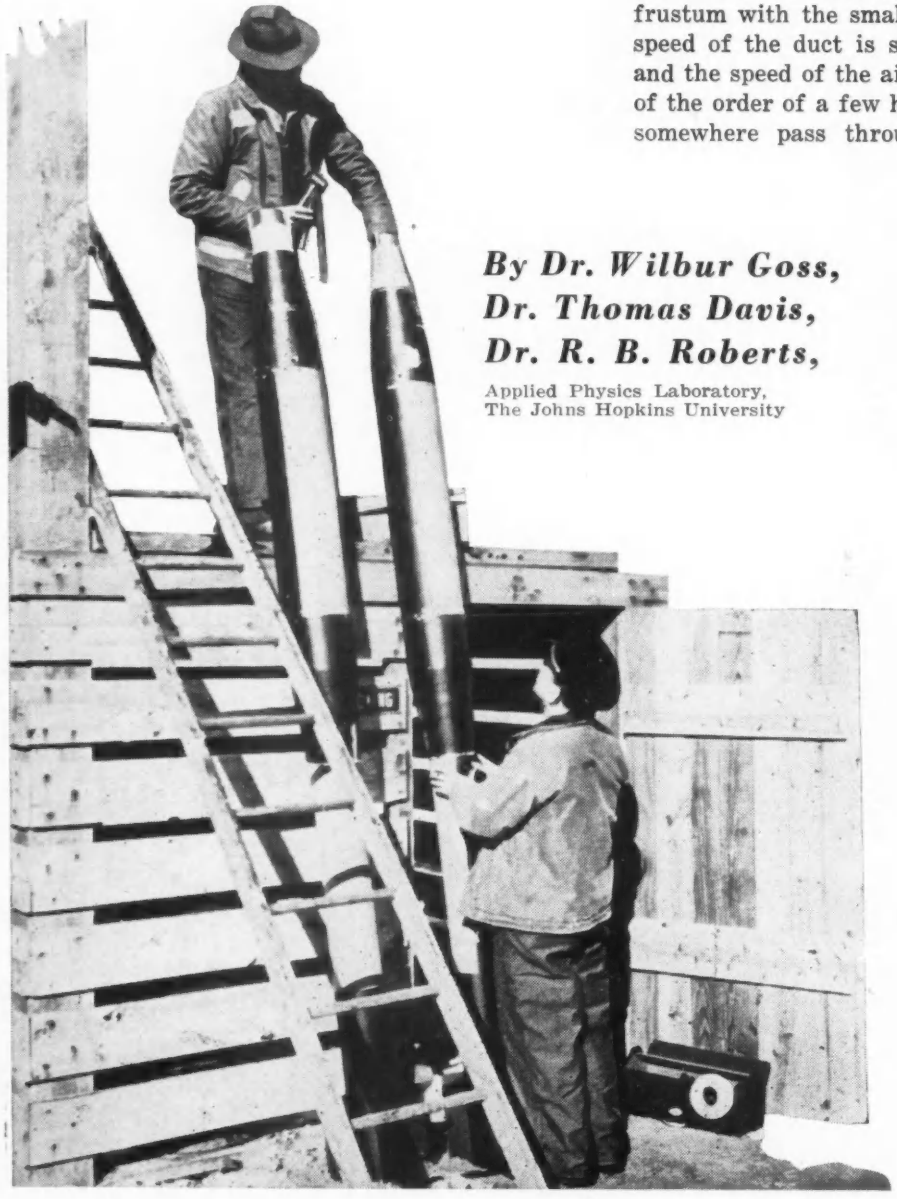
FUNDAMENTALS of the ram jet engine, a device for propulsion in flight at supersonic speeds up to 1500 mph, are presented in this article by three members of the staff of the Applied Physics Laboratory at the Johns Hopkins University. Although the ram jet theory has been known for years, it was not developed as a practical method of propulsion until World War II when the Navy's Bureau of Ordnance, the Johns Hopkins laboratory, and 20 industrial organizations cooperated on the project Bumblebee. A number of successful working models were built, the complete assembly of one weighing about 70 lb with a potential output of 2240 hp.

By Dr. Wilbur Goss, Dr. Thomas Davis, Dr. R. B. Roberts,

Applied Physics Laboratory,
The Johns Hopkins University

THE ram jet (often called an athodyd) is composed of three principal sections; the forward part is known as the diffuser, the middle part is a combustion chamber, and the latter part is the exhaust nozzle. The arrangement of these parts is shown in the drawing. The function of the diffuser is to receive air at atmospheric pressure and high velocity, and by subsonic expansion increase its pressure to the highest value practicable. The combustion chamber furnishes a flame front which increases the momentum of the air, thus creating a back pressure supporting that developed in the diffuser. It is essentially from this phenomenon that the ram jet gets its thrust. The pressure of the air in the diffuser exerts a forward thrust on the diffuser inner walls, and the reaction is against the exhaust gases. Exhaust nozzles are variously simple constrictors, straight ducts with no constriction, or a combination of constriction and expansion. The matching of the three sections of the ram jet involves some thermodynamic balancing (1*), but certain aspects are easily understood.

There are three types of diffusers that can be used to obtain desired recovery pressure. The simplest is a conical frustum with the small end used as the intake. Since the speed of the duct is supersonic relative to the intake air, and the speed of the air in the diffuser exit is subsonic and of the order of a few hundred feet per second, the air must somewhere pass through the sonic speed while slowing down. The laws of conservation of energy, momentum, and mass flow require the formation of a normal shock wave (2) for the change-over through the transonic region. Amazingly abrupt changes in pressure and velocity occur in this shock region which is only a small fraction of an inch in thickness. For example, air moving at 1800 fps and at atmospheric pressure changes across this thin bundary to air at 900 fps and nearly three times atmospheric pressure. Now, it can be shown that maximum thrust will be obtained when this normal shock wave is located at the nose or entrance of the diffuser. If the burner pressure is higher than the design value, this shock wave will be detached and a certain amount of air will spill around the nose, resulting



A ram jet model being readied for flight.

* This number and others that follow refer to explanatory paragraphs of the same respective numbers in comments by Dr. Davis at the end of this description of the ram jet engine.

Supersonic Ram Jet Engine

in an effectively reduced intake area. If combustion pressure is too low, the shock wave will enter the diffuser but the mass flow of air will continue to be the same as when the shock was on the nose.

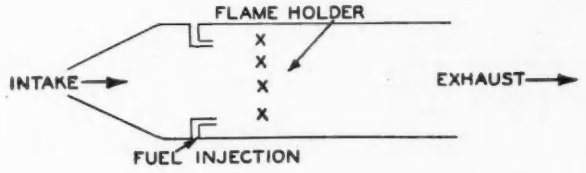
The normal shock wave is characterized by an increase of entropy. This means that some of the energy of the gas has gone into heat irreversibly and the maximum pressure that can be recovered by the diffuser is somewhat reduced. Up to supersonic speeds less than twice the velocity of sound, this pressure loss is not large (3). At the higher speed, however, some means of approximating isentropic compression in supersonic speeds is imperative. The simplest method that suggests itself is the use of the so-called reversed De Laval nozzle. In this arrangement the supersonic air stream is taken into a contracting duct and pressure is increased isentropically (4) until sonic speed is reached at the minimum section, the throat. From this point on, the duct expands as a normal diffuser, velocity subsonic and decreasing, and pressure increasing. This system, is, however, unstable in certain ways. If the speed of the air past the duct is sufficiently increased to attach the shock to the nose, it will suddenly jump inside to the expanding part of the diffuser (5). Then, as the speed is decreased, the shock wave will move up the diffuser and tend to disappear at the throat. A slight further decrease in speed will cause the shock to jump to a detached position. Some scheme has to be devised to permit controlling of shock wave position if isentropic compression is to be obtained.

Another method of preventing large loss in entropy due to compression at high supersonic speeds is to use a series of diagonal or conical shock waves (6) such as are produced around the point of a cone, to obtain a multi-stage compression in the supersonic region of flow. The cone is a central body and the duct scoops the air from around the cone.

The combustion chamber of the ram jet is similar to that of other jet engines, with the added difficulty that stable flames must be established at considerably greater speed of air flow. A balance must be struck between a sufficiently elaborate igniter to burn the fuel completely and uniformly, while at the same time not producing an excessive drag force, thus reducing the available net propulsive force.

Expanding or converging-diverging exhaust nozzles produce little gain in thrust until velocities greater than twice the velocity of sound are reached. It can be easily shown that the speed of the exhaust gases at the minimum section will be the speed of sound for the local conditions of temperature and pressure, and that the pressure at this point is about half the combustion chamber pressure. If one is operating at high speeds, the combustion pressure will be high and consequently the exhaust pressure may be sufficiently above atmospheric pressure to warrant an expansion section from which additional forward thrust would be obtained.

The basic difficulty in research work on ram jets is that they cannot be tested statically—either the ram jet must be moved through the air as in free flight or the air must be moved past the ram jet as in a wind tunnel. Since the most promising region for operation is at velocities in excess of that of sound, either of the above two tasks poses formidable technical problems. The cost and immensity of the installations required for supplying air at the proper temperature and pressure have been a deterrent to this line of attack. It required the pressure of wartime needs



Elements of a Ram Jet.

to initiate such a program.

There are several different ways of assaying the performance of ram jet engines once such facilities are available. One can attach the intake of a ram jet directly to the source of air, and by appropriate adjustments of temperature and pressure reasonably simulate flight intake conditions. By making pressure surveys along the duct, certain conclusions about thrust can be evaluated. The addition of a direct thrust measurement of some sort is, however, essential for good quantitative data. There is also a method which more nearly simulates flight conditions by placing the ram jet intake in a supersonic air stream, the so-called free jet. Size considerations at the present time preclude the use of supersonic wind tunnels to duplicate sea level flight conditions on full-scale flight models.

In free flight tests, both internal thrust and external drag are evaluated. The duct is first flown cold with a tail constriction, to simulate the flow conditions produced by a burner. Internal drag can be calculated from the flow condition and total drag is obtained

from the deceleration rate shown from the velocity time curve. The unit is then flown with the burner operating, and the thrust of the unit calculated from the excess of thrust over drag.

It is immediately seen that the total internal thrust, which is the integral of all the forces from the internal surface of the duct, is simply the difference between the momentum of the exhaust gases and the intake air. The intake momentum is a function of atmospheric conditions, geometry, and speed, while the exhaust momentum depends principally on temperature and the mass flow of air.

On the ground, instrumentation is rather complete and it is accomplished without great difficulty. In flight, however, it is necessary to employ the methods of telemetering. Pressures, accelerations, temperatures, fuel flows, and so forth, must all be converted into a radio signal which is broadcast from an antenna integral with the ram jet and then picked up and analyzed by field equipment at the test site. It has been necessary to develop equipment so small and compact that a four-channel system complete with power supplies, measuring instruments, and broadcasting equipment could be contained in a space only slightly larger than a man's two hands. This could not have been done without the components developed for the proximity fuze. The successful development of this telemetering technique has greatly augmented the intelligent analysis of individual flight tests and thereby speeded up the development program in general.

Using the techniques described above, it has been possible to demonstrate both in combustion tests in the laboratory and in free flight, the attainment of thrusts commensurate with those predicted by theory. Thrust alone, however, is not the most striking performance criterion, as is easily realized when one compares the total weight of certain of the test missiles launched to the horsepower they develop, and arrives at a figure of less than ½ oz per hp as compared to roughly one lb per hp for the standard piston engine. Of course, the high fuel consumption must also be considered in arriving at an over-all comparison.

Comments by Dr. Davis

DR. DAVIS, a co-author of the foregoing article, at the request of AUTOMOTIVE AND AVIATION INDUSTRIES makes the following technical comments on some important parts in the description:

1. Discussion of thermodynamic balancing necessary in matching the three sections of the ram-jet:

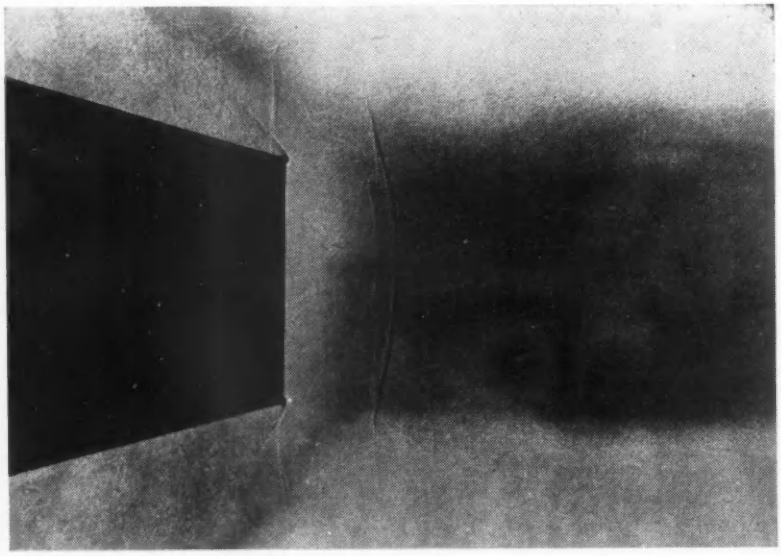
Dr. Phillip Rudnick suggested that we give the name stream thrust to the quantity $A\ (p + \rho\ V^2)$ which occurs in all expressions involving forces in duct analysis. It is a unidimensional flow expression and with some modification is satisfactory for analytical purposes. It is this stream thrust which is conserved across normal shock or flame front and of course represents conservation of momentum. The equality of the stream thrust across the flame front in the burner section may be expressed as follows (see Nomenclature Table):

$$S_a\ \phi\ (M_b) = S_o\ \phi\ (M_2)\left(1 - C_{db}\ \delta\ (M_2)\right)$$

This matches the diffuser exit to the combustion chamber. The quantity S_a, momentum specific impulse referred to mass flow of intake air, is a measure of the condition of the exhaust gases, principally the temperature, but also to some extent the dissociation as indicated by the change in specific heat. S_o corresponds to intake conditions. This type of specific impulse may be written as follows:

$$S = \frac{F_m}{\dot{m}} = \frac{\sqrt{2\ (\gamma + 1)}}{\gamma g}\ C_s$$

The fact that the Mach number of the exhaust may be taken as unity gives the special significance to the exhaust specific impulse. As long as the pressure ahead of the flame is one atmosphere gage or higher, the ratio of pressure ahead of flame to exhaust will be critical and assures sonic speed at the tail, which of course is the condition for Mach number 1. Developed flame pressure in ramjets at Mach numbers less than 2, will have an exhaust pressure about two atmospheres gage or less. In order to get thrust from the pressure drop of exhaust



Spark photograph of flow conditions at the ram jet inlet showing shock wave.

to atmosphere, it would be necessary to have an expanding section at the tail. In most of our work we have found it unnecessary to have a constrictor or an expander at the exhaust. The gains to be obtained are small.

2. Brief description of "shock wave" and its entropy characteristic:

First let me point out that entropy is not lost in this process. This is a misnomer which is in common bad usage. There is, of course, an increase in entropy across a shock wave, presuming that you are moving in the direction of the air stream. Confusion comes from the fact that there is a loss of available recoverable pressure associated with this gain of entropy. The actual quantitative gain in entropy across the shock wave is a function of the Mach number and the specific heats of the gas. Its numerical value, however, is not particularly useful in ramjet problems and hence it is not being included here.

A normal shock wave is a necessary result of the conservation of energy, mass flow, and momentum, as an air stream passes from the supersonic to subsonic flow. These three laws may be expressed as follows:

$$\text{Energy } \frac{C^2}{\gamma\ 2-1} + \frac{V^2}{} = \text{constant}$$

$$\text{Mass } \rho VA = \text{constant}$$

$$\text{Momentum } p + \rho\,\sigma^2 = \text{constant}$$

In compressionable flow, air viscous forces may be largely neglected. Mach number is a useful nondimensional parameter for the expression of flow characteristics. The expression for Mach number after normal shock in terms of the Mach number before normal shock is based on the above laws and is as follows:

$$M\sigma^2 = \frac{1 + \frac{\gamma - 1}{\gamma + 1}(M^2 - 1)}{1 + \frac{2\gamma}{\gamma + 1}(M - 1)}$$

The pressure ratio across shock may be written as:

$$p\sigma/p = 1 + \frac{2\gamma}{\gamma + 1}(M^2 - 1)$$

Diagonal shock waves are produced when there is a disturbance with insufficient intensity to change the flow from the supersonic to the subsonic regime. The pressure drop across these will vary anywhere from practically zero for mild disturbances up to that across normal shock.

3. Explanation of reasons behind statement: "Up to supersonic speed less than twice the velocity of sound, this pressure loss is not large":

If one starts with air at Mach number 2, takes normal shock by putting in some sort of obstruction and has isentropic compression to zero velocity, he will obtain 72 per cent of the pressure that he would have gotten had he been able to produce isentropic compression from the start. If some tricks are used to decrease the gain of entropy a considerable proportion of the 28 per cent pressure loss may be recovered. This gain in pressure working against the diffuser represents a direct increase in thrust. Above Mach number 2 it increases very rapidly over the 28 per cent value quoted. At Mach number 1.6, where we are now designing ramjets, pressure loss due to the use of a normal shock diffuser is only 10 per cent.

4. In the so-called reversed De Laval nozzle, pressure is increased and speed is decreased along a converging duct. (The inlet section.) Explanation of why this is true and how it differs from the supersonic case where

(*Turn to page 67, please*)

Nomenclature Table

SYMBOLS:

V—velocity	c—speed of sound
M—Mach number	p—static pressure
C—coefficient	ρ—density
S—specific impulse	γ—ratio of specific heats
A—area of cross section of duct	g—acceleration of gravity
m—mass flow	
F—stream thrust	

$$\phi(M) = \frac{1 + \frac{\gamma}{\gamma + 1}(M^2 - 1)}{M\left(1 + \frac{\gamma - 1}{\gamma + 1}(M^2 - 1)\right)}$$

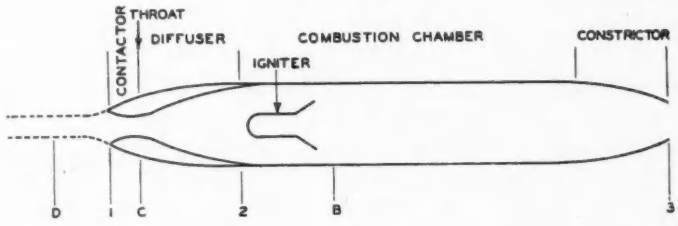
$$\delta(M) = \frac{1}{2}\left(\frac{\gamma M^2}{1 + \gamma M^2}\right)$$

$$F = F_m\,\phi(M)$$

$$F_m = S_m = \frac{\sqrt{2(\gamma + 1)}}{\gamma g} C_s m$$

SUBSCRIPTS:

a—air (after combustion)	σ—immediately after shock
d—drag	o—initial
s—stagnation	m—minimum value



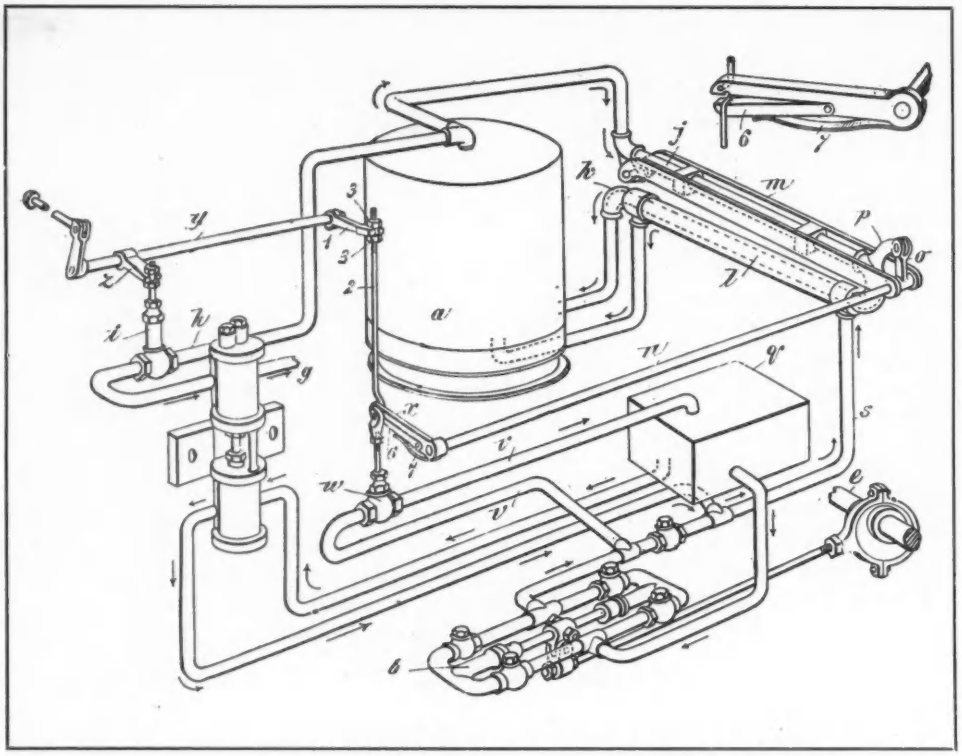


Fig. 19—Victor (Bullard) automatic boiler feed system.

a, boiler; **b**, double-barreled plunger pump; **e**, pump-operating eccentric shaft; **g**, exhaust pipe of steam pump; **h**, steam pipe for pump; **i**, control valve of steam pump; **j**, unjacketed tube of thermostatic valve; **k**, jacketed tube of thermostatic valve; **l**, jacket of thermostatic valve tube; **m**, one of the two steel bars of the thermostatic valve; **p**, bracket on unjacketed tube; **o**, lever arm; **n**, control shaft of bypass valve; **q**, water tank; **s**, feed pipe; **y**, hand-control shaft for bypass valve and steam-pump valve; **z**, hand-control arm of steam-pump valve.

Rise a

By P. M. Heldt

In 1904 the Stanley Brothers brought out a new model which showed many improvements over their previous designs. The steam was superheated by allowing it to expand through an orifice to a lower pressure, but this principle was later abandoned again. A high boiler pressure (400 psi instead of the previous 200) was carried; a water-level indicator replaced the fragile water glass; the fuel-feed system was redesigned so that only a small fraction of the fuel supply was under air pressure, and the engine was completely enclosed and geared directly to the rear axle. This car had a wheelbase of 79 in., as compared with 56 in. for the original Locomobile, and was a runabout with a front compartment that could be opened to form a seat for two additional passengers.

That the Stanleys reengaged in the manufacture of steam cars immediately after their contract with Barber and Walker had been completed must have been very annoying to the Locomobile and Mobile organizations, but there seems to have been nothing in the contract to prevent them from doing so. After the Locomobile Company had acquired control of the Whitney patents, it brought suit for alleged infringement of these patents against the Stanleys. A representative of the company at the time issued a statement in which—referring to the suit—he said:

"The Locomobile Company controls the Whitney Motor Wagon Company and is back of these proceedings, and will push the suit as vigorously as possible. We consider that the Stanley Brothers have treated us very shabbily, as after selling us all their patents, they followed by themselves manufacturing steam vehicles and offering them for sale at a lower price. We believe that the Stanley patents which we acquired are of minor value to the Whitney patents, although

THE Victor steam car had an automatic boiler feed system, the invention of James H. Bullard, of which a diagram is shown in Fig. 19. Two pumps were fitted, a double-cylinder, single-acting plunger pump driven positively from the rear axle through gearing, and a steam pump. The former supplied the feed water while the car was in motion, the latter while it was at rest. Feed was regulated by a bypass valve under the control of a thermostat. The latter consisted of a small-diameter tube running once back and forth across the body back of the boiler, and connecting to the boiler at top and bottom. The lower branch of the tube was jacketed and cooled by feed water, while the upper branch was fastened at one end to a pair of steel plates extending all the way across the body, one on each side of the tube. On the opposite end the two arms of the tube were connected by a fitting which also formed the inlet to the jacket. This fitting was provided with an upwardly projecting arm, to which was pin-jointed an arm on a rocker shaft controlling the bypass valve. As the water level in the boiler rose and fell, the upper arm of the thermostatic tube alternately filled with water and steam. When water was replaced by steam, the temperature rose and the tube expanded. The length of the steel plates remained constant, and the expansion of the tube resulted in a slight angular movement of the rocker shaft, which closed the bypass and allowed the water to enter the boiler. The reverse action took place when water level rose above normal.

and Decline of the American Steam Car Industry

important in that they cover certain useful structural details."

The suit was brought early in 1902. Some time later it was announced that it had been withdrawn, but no explanation for the withdrawal was given. About 20 years later, when the last of the Stanley brothers died, an obituary appeared in a Boston paper in which it was stated that the brothers had sold their steam-carriage business for a quarter million dollars and had later bought it back for $30,000. This lent substance to the belief that the suit had been settled out of court.

During the first year of the Locomobile Company's activities it enjoyed a sellers' market if ever there was one. This applies particularly to the demand for agencies. It was only a short time after the catastrophic collapse of the bicycle business, and many former bicycle jobbers and dealers were looking for new outlets for their energies. Many others also had become interested in the new mode of locomotion, through the five years of agitation which had preceded it, and were willing to cast their lot with the new industry. Conditions at the Locomobile plant are reflected by an experience of the late Carl Fisher, of Prest-O-Lite fame. He had been a bicycle racer in his early years, and wished to get into the sales end of the horseless carriage business, so he went to

Part Four

This is the concluding part of this series of articles. The first three parts appeared in the three issues immediately preceding.

The development of the steam engine, however, is not by any means at an end. High-speed designs, the vertical multi-cylinder type modeled on the Diesel engine, and the adaptability of the steam engine in general to the demands of marine propulsion, traction and even aviation, still hold great possibilities which can only be hinted at here. In all of these varied spheres of application the steam engine has definite advantages to offer.

It is at any rate a mistake to believe that the steam engine is obsolete, or to dismiss it with the unfounded assertion that it can only be used for low pressures and for saturated steam or slight superheat. Adaptation to high steam pressures is on the contrary a simple matter in the reciprocating engine, and as far as temperatures are concerned the upper limit of admissibility for the modern Sulzer steam engine has already been shown to lie in the neighborhood of 400 C.—O. Walti in Sulzer Technical Review.

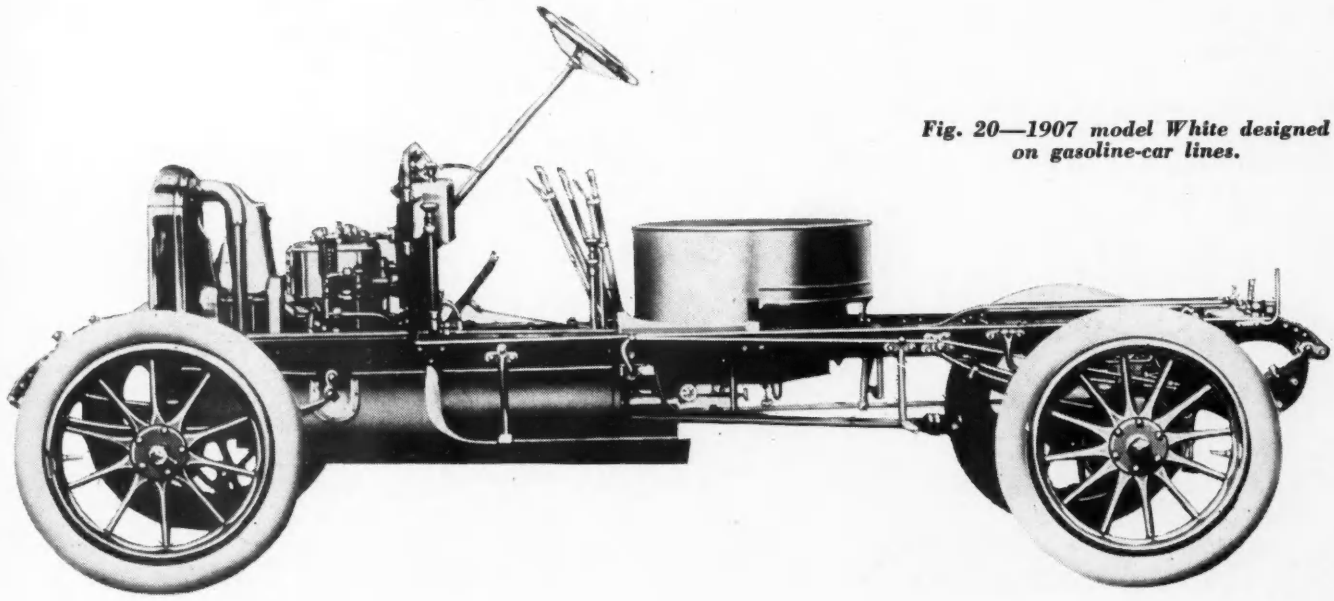


Fig. 20—1907 model White designed on gasoline-car lines.

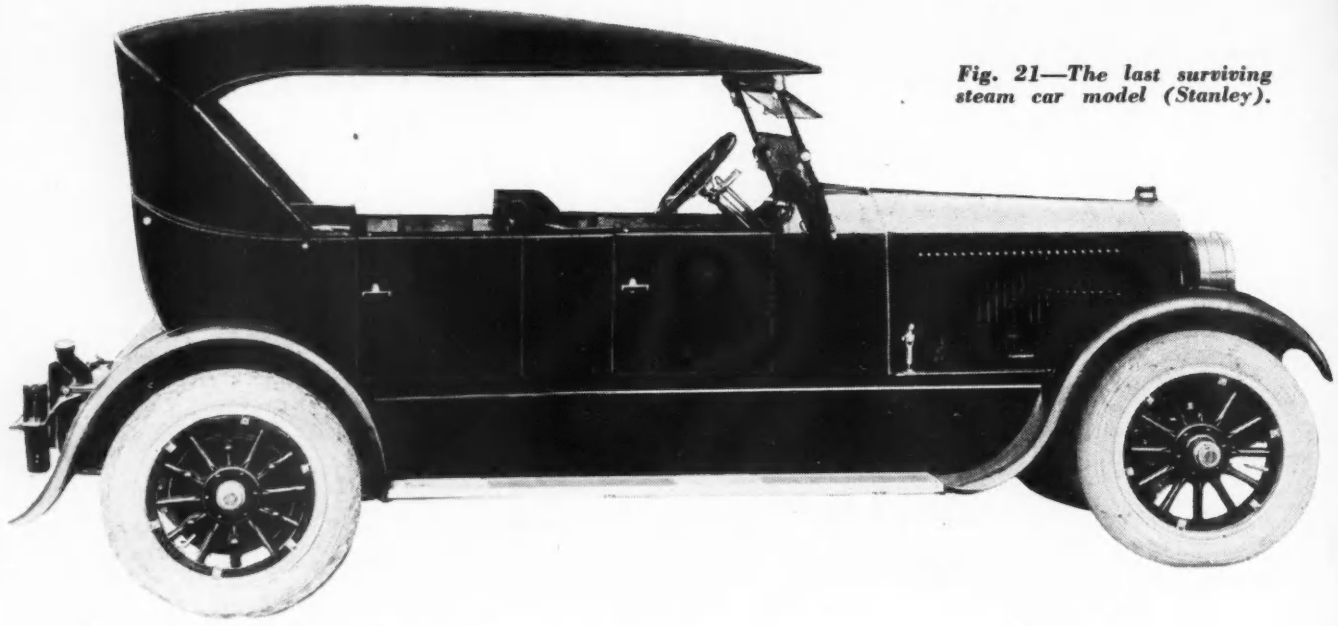


Fig. 21—The last surviving steam car model (Stanley).

Bridgeport with the object of securing an agency. But after sitting in the outer office for three days without getting a hearing, he gave up and went to Tarrytown, where he secured the Indiana State rights for the Mobile. This reference to "three days in the outer office without getting a hearing" may bring back memories of similar experiences in Bridgeport to some oldtimers who may read this, for the habit of showing little regard for the sensibilities of business callers persisted at the Locomobile plant long after the sellers market had vanished.

All of the earlier steam vehicles were essentially runabouts, and designs for carrying more than two passengers were makeshifts of one kind or another, such as dos-a-dos, cars with collapsible front seats, etc. About 1903, however, the demand for touring cars became very insistent. This compelled manufacturers of steam cars to rearrange their powerplants, so that the body could be designed practically without regard to the powerplant. The chassis of a White 1907 limousine, with the boiler under the front seat and the engine under the hood, is shown in Fig. 20.

It was in connection with steam cars that the practice of selling through dealers was first introduced in the automobile industry, for the early manufacturers of gasoline cars produced on such a small scale and the more successful ones had such a demand for their vehicles that they had no need for agents. One of the first dealers was James A. Kline of Harrisburg, Pa., who secured the Mobile agency in 1900. Kline tells of some of the difficulties encountered by the owners of these early vehicles substantially as follows:

"After a novice had been taught how to operate the machine and was left to his own resources, about the first thing he did was to forget to turn on the water from the feed pump to the boiler. This resulted in burning out the boiler, which usually meant re-expanding the tubes, at a cost of about $10. After the boiler had been burned out about three times, the tubes, where they passed through the header plates, became so thin that it was impossible to make a steam-tight joint by re-expanding, and a new set of tubes at a cost of about $60 was then necessary.

"Another difficulty was to keep the water gage intact so it would correctly indicate the water level in the boiler. As a pressure of about 200 psi was carried, the glass would often break, and until it was replaced you had to guess at the amount of water in the boiler. Replacing the glass with the pressure on was a difficult job, as the rubber gaskets would blow out, and if the gland nuts were screwed up too tight, the glass tube would break.

"The greatest difficulty of all, however, was to keep the fire going properly on a windy day when the car was standing. After the burner had been lit for some time and the vaporizer heated up, the pressure regulator acting on the fuel supply was supposed to keep the pressure down to 200 psi automatically. This was somewhat lower than the pressure for which the safety valve was set, and to keep the pressure within this limit, the fire naturally had to be burned very low, with the result that the least gust of wind would cause a 'back-fire,' that is, burning of the vapor where it issued from the gasoline nozzle at the side of the burner. In a little while the vaporizing device, which was heated by the main burner, would cool off sufficiently to allow raw gasoline to flow from the burner nozzle and flood the burner. Then, if one was not careful, he would light the burner, and the result was a fire. However, as long as the car was under way the burner usually worked well, for then the fire was going full tilt and, besides, the exhaust steam was directed down the discharge flue for the burnt gases."

Agreat deal of trouble was experienced with the wire wheels of the early light steamers, which were much too light in both the spokes and the rims. At that time owners were not averse to paying $50 for a set of wood wheels to replace the wire wheels, a condition of affairs which was reversed some time later

(*Turn to page* 70, *please*)

Revacycle Gear Cutting and Tire Press

Two Innovations

at the Fort Wayne Plant

By Joseph Geschelin

ONE of the most striking innovations of recent origin at the Fort Wayne Works of the International Harvester Co. is the adoption of the Gleason Revacycle principle in the mass production of straight bevel gears for differentials. The Revacycle operates on the Gleason Formate principle in which a single circular cutter of large diameter is employed for the rough and finish cutting of an individual gear tooth in one revolution. In this cycle, the gear is held stationary during the progression of the cutter and is indexed automatically one tooth at a time until all teeth have been cut. The cutter contains a gap between the roughing and finishing sections and this gap provides the time interval required for the indexing of the gear. The operation of the machine is completely automatic.

At the present writing IHC has installed a battery of two of the Gleason No. 8 Revacycle machines, one for the 16-tooth differential side gear, the other for the 9-tooth pinion of a 9/16 differential assembly required in large quantity. The two machines together with several additional detail operations are handled by a single operator. The new method is considered by the management to be the last word in automaticity and is responsible for greatly increased productivity and lower prime cost. Perhaps the best way to express the economy of the method is to say that whereas the former Gleason generators—the most modern of their type—produced the differential side gear in two minutes, at the rate of 30 pieces per hour, the Revacycle takes only 0.895 min. per piece or a rate of 67 pieces, plus, per hour.

(*Turn to page 84, please*)

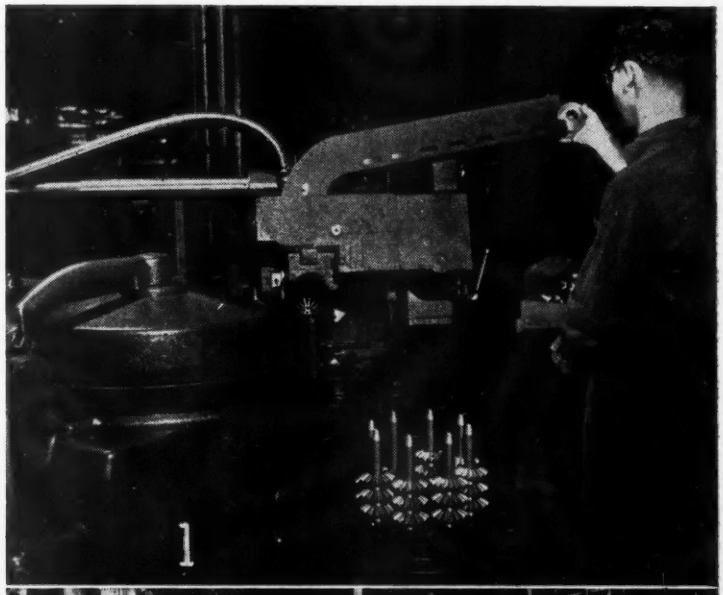


Fig. 1—Close-up of work station of the Gleason Revacycle machine installed at the Fort Wayne Works of the International Harvester Co. The machine shown here cuts differential side gears; a similar unit handles the pinions. The magazine feed hopper may be seen at the right, a finished gear in the center, and the container for finished gears in the foreground. The hopper for transferring finished gears to the container already is in position directly under the work spindle. The Revacycle cutter is at the left under the hood

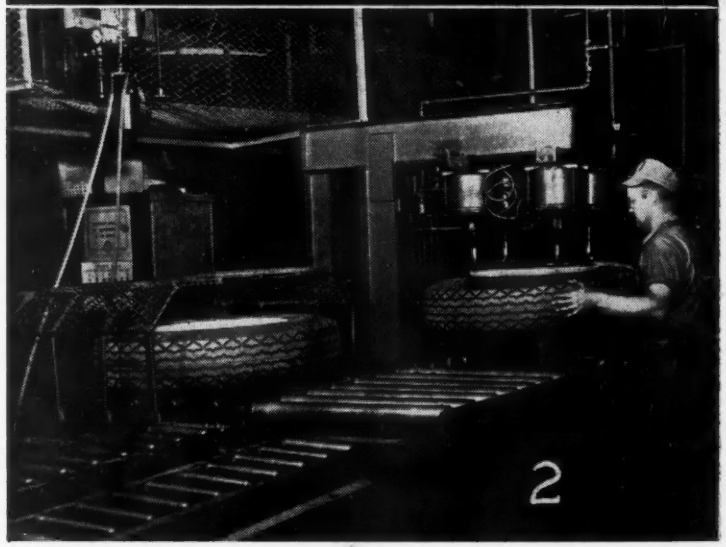


Fig. 2—Here is a view in the IHC heavy tire assembly department. The hydraulic press described in the text is at the right with the tire elevated into position for pressing-on the side ring. The tire inflation chute may be seen at at the left

Pratt & Whitney

Wasp Major

NEW and revised specifications and curves for all current unrestricted Pratt & Whitney aircraft engines have just been released. Among them is the 28-cylinder Wasp Major designated as the TSB3-G model, a slightly heavier and more powerful model as compared to the earlier VSB11-G which is rated at 3000 bhp for take-off at 2700 rpm. The VSB11-G differs from the TSB3-G model in that it incorporates a single stage, variable speed integral supercharger whereas the latter 3250 hp version has a single stage, single speed supercharger and is suitable for use with an exhaust driven turbosupercharger. Performance curves and specifications of the TSB3-G model are given in the accompanying charts and table. A cut-away view of the VSB11-G model is shown here.

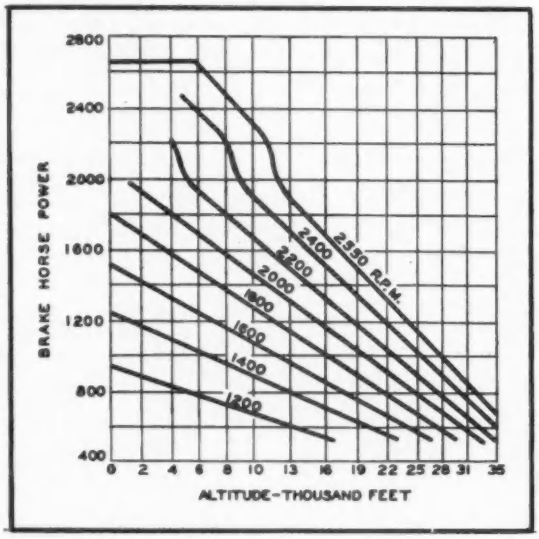
The B4 helicopter engine is a version of the single stage, single speed Wasp Jr. engine for operation with the crankshaft in a vertical plane. This engine is equipped with a Stromberg NA-R9B float type car-

TSB3-G Engine Specifications

Take-off power:	
With water injection	3500 bhp at 2700 rpm, 500 ft altitude
Without water injection	3250 bhp at 2700 rpm, 700 ft altitude
Normal rated power	2650 bhp at 2550 rpm, 5500 ft altitude
Maximum continuous power	2800 bhp at 2550 rpm, 3500 ft altitude
Description and dimensions:	
Supercharger*	Single stage, single speed
Type	28-cyl. air-cooled radial
Bore and stroke	5.75 by 6.00 in.
Piston displacement	4363 cu in.
Reduction gear ratio, propeller drive	0.375 to 1
Engine diameter, maximum	53.50 in.
Engine length, maximum	96.75 in.
Fuel knock value CFR method, F3 lean, F4 rich	115/145
Dry weight including standard accessories	3470 lb

Standard equipment included in dry weight:
Stromberg PR-100B3 pressure injection carburetor
Carburetor air screen
Seven Scintilla D4RN-2 shielded pressurized magnetos
Water regulator
Primer system

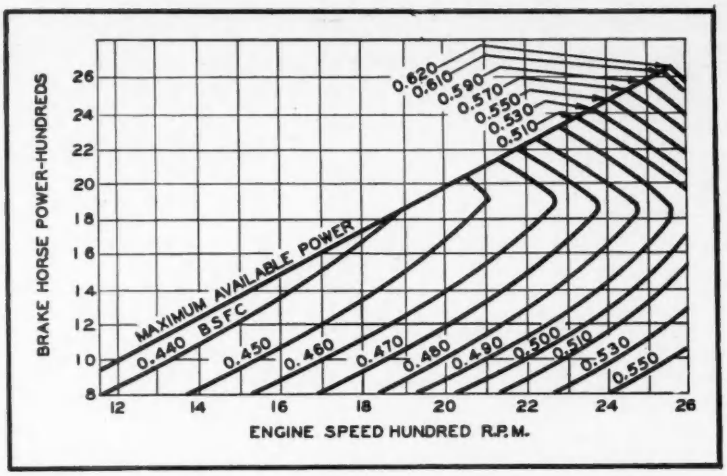
*Engine is suitable for use with exhaust driven supercharger.



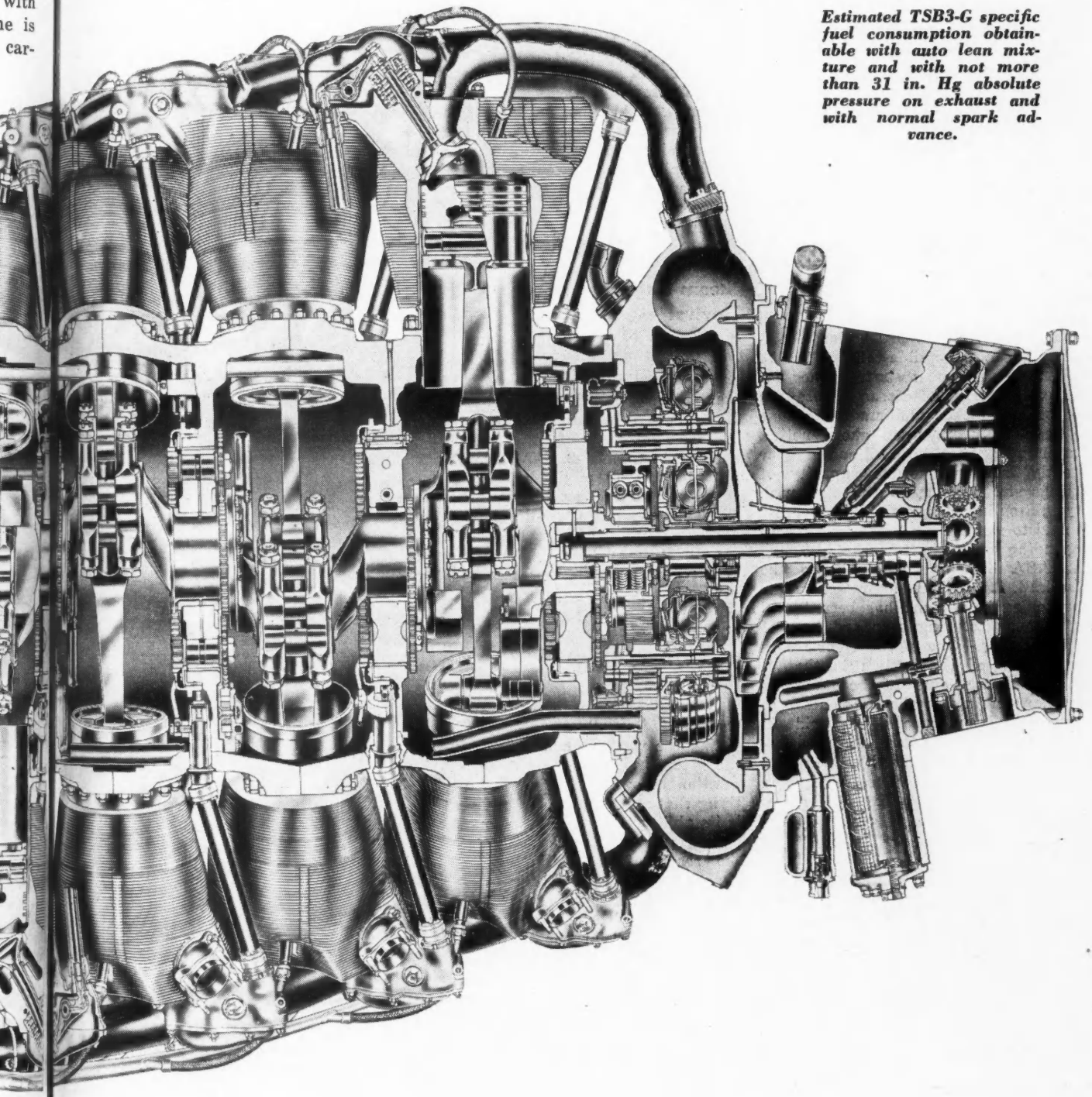
These altitude power curves for the Wasp Major TSB3-G engine are based on standard atmospheric temperature and pressure in the carburetor proper (estimated auto lean mixture) and standard altitude atmospheric pressure on the exhaust. Propeller gear ratio 0.375 to 1; fuel grade 115/145.

Engine

buretor and pressure type cooling deflectors. It weighs 684 lb, including standard accessory equipment, and is rated at 450 bhp operating at 2300 rpm.



Estimated TSB3-G specific fuel consumption obtainable with auto lean mixture and with not more than 31 in. Hg absolute pressure on exhaust and with normal spark advance.



Observations

BY JOSEPH GESCHELIN

Involute Splines American Standard

ONE OF THE MOST important developments of recent origin is the final approval of the American standard for involute splines, superseding in mass production the old six-tooth straight spline standard which has been known for over 30 years. The new standard covers a range of 14 D.P. sizes in one standard depth for each size as contrasted with three different tooth depths for the old standard. Among the greatest advantages of the involute spline is that the range of 14 sizes takes care of the gamut of shafts from the smallest used in instruments to the largest of industrial drives. Moreover, instead of being confined to six teeth, it permits the use of from six to 50 teeth depending upon shaft size. From a production standpoint it is now possible to have but 14 different hobs to cut shaft splines for the entire range of sizes. These can be readily stocked and made available to manufacturers upon short notice. Major advantage to designers is the greatly increased torque capacity of fittings size for size as compared with straight-splined fittings. The increase is said to range from 25 to 40 per cent depending upon shaft size. Although the ASA has not yet published the standard, it has been approved by the sponsoring bodies and has been issued as a manufacturing standard by GM and Chrysler. One of the other major advantages of the system is that it lends itself to the use of the broaching technique in finishing bores for all mass production applications — a field in which broaching is said to excel because of high productivity, low cost, and great precision.

Surplus A Myth?

IN RECENT NEWS despatches Senator Mead is quoted as saying that something has happened to the critical surplus materials slated for return to the U.S.A. Whatever it is, these materials were spread over the globe but are not coming home to roost. This puts a serious slant on some private correspondence we received recently. Take the case of aluminum. Almost fantastic tonnages of aluminum were produced during the war and fabricated into airplanes and other military equipment, then spread over the face of the globe. It had been assumed this material would return to form the nucleus of an enormous stock pile of secondary metal. In fact, some of the applications of aluminum in passenger cars and trucks were predicated on the use of secondary metal as a matter of economy, the price of virgin material still being out of reach for heavy castings. Lately it seems to be the opinion that none of the potential stock pile has materialized. Unless somebody finds its somewhere overseas our economy will have to be geared to virgin aluminum exclusively.

Steam Engine Revival

APROPOS OF THE series of articles on the history of the steam driven vehicle prepared by P. M. Heldt for this publication, we have learned unofficially of considerable new activity in this field. We have not yet put our fingers on it, but we understand that some prominent organizations are aiming at the development of a steam engine of advanced type for use in large vehicles such as buses. Won't that make interesting reading.

Educating The Worker

AN IMPORTANT problem facing all employers is that of giving the worker an understanding of the mass production technique and its relation to our economic system. The thing that makes mass production work is its ability to produce consumer goods by the millions of units at a cost within the reach of the pocketbook of the American people. By the use of high-priced mass production machinery costs are reduced although worker's wages are maintained at the highest levels. Workers always have been suspicious of the introduction of cost-reducing machinery because this equipment greatly increases productivity per worker. They have not been able to understand that in the aggregate the use of mass production techniques has constantly increased employment and job opportunities and has been instrumental in launching entirely new products. These facts must be more widely publicized.

Making the Workers Task Easier

RECENT TRIPS through plants of the industry have disclosed an increasing tendency to make the worker's task easier by reducing manual effort, by the adoption of materials handling devices, by an increase in the automaticity of machines. We went through one plant recently where a long battery of Cincinnati centerless grinders has been made completely automatic in operation and supervised by just one machine tender. The work is transported on a belt conveyor, deflected to each machine by an arm fitted to the conveyor frame. The work then moves by gravity and by pressure into the magazine feed, through the machine, and out at the other end through a chute onto another belt conveyor. The entire department has been fitted with belt conveyors, replacing monorail conveyors, so as to make it unnecessary for the worker to lift parts from the machine and raise his arm many times a minute to hook work onto the conveyor.

Plastic Gaskets For Sealed Cooling

TEFLON—THE NEW plastic recently announced by du Pont possesses the unique properties of chemical inertness and resistance to high temperatures. Although new to industry, Teflon was made for the Navy during the war but remained on the secret list until recently. One of its possible applications is in the form of gaskets for the sealed pressure cooling systems or evaporative cooling systems which are under investigation at the present time. Although the material can't compete in price with conventional gaskets, it would pay off in places where conventional gaskets will not do. If you are interested, we believe du Pont will be glad to experiment.

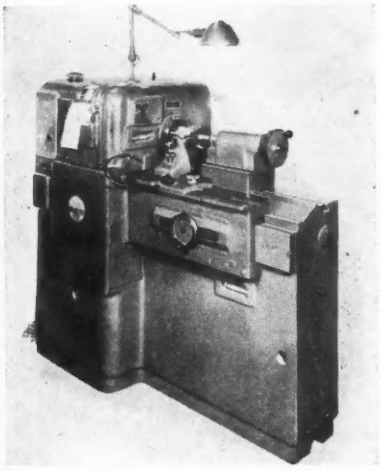
Powder Metals

ONE OF THE MAGneto producers tells us that the small timing gears which have been made of fiber in one form or another from time immemorial are going to change. For their use, it is planned to make gears of powdered iron in much the same way as oil pump gears for many cars have been produced for some years. It is said that the overall cost of the gear should be reduced thereby.

New Production and Plant Equipment

THE FELLOWS GEAR SHAPER CO., Springfield, Vt., has recently placed on the market a new instrument for checking the lead of helical gears and other surfaces.

Known as the Fellows No. 12H lead measuring instrument, it incorporates an arrangement whereby the lead of a helix is checked by the continuous



Fellows No. 12H lead measuring instrument

motion of a measuring pointer, in conjunction with the desired rotation of the work. If the work being checked is of the correct lead then the dial indicator remains stationary. If there is an error in lead, the indicator needle indicates the displacement of the helix in the face width being measured.

The principle comprises two tangent bars and pins, both of which operate slides. One of these slides effects the traverse movement of the member carrying the measuring pointer and the other controls the rotation of the work. The contact positions of the pins on the tangent bars are set by means of size blocks and micrometers, and dial indicators are provided so that the setting pressure can at all times be accurately maintained. Errors in gears can be checked by using the dial indicator carried on the measuring slide, or a chart can be made for a permanent record.

An integral part of this instrument is an electrical recorder which automatically produces a record of the displacement of the toothface on a paper chart.

The contact points of the pins on the tangent bars are independently adjustable, so that it is possible to have traverse of the measuring pointer without rotation of the work, and rotation of the work without traverse of the measuring pointer.

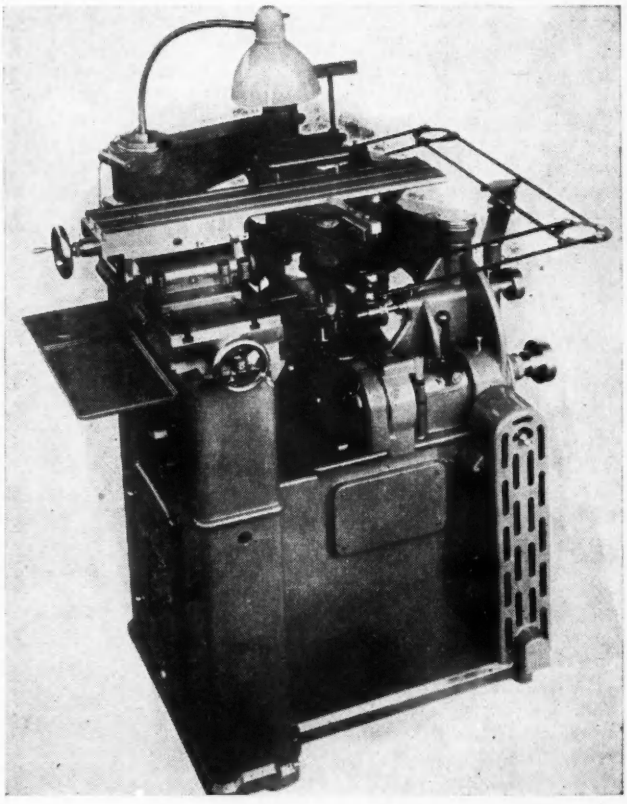
TURCO PRODUCTS, INC., 6135 South Central Ave., Los Angeles 1, Calif., announces a new all-metal, heavy-duty, hand soap dispenser for use in industrial plants. White, vitreous porcelain and chrome have been used to carry out the modern design. Rounded edges of the design preserve the life of the finish. There are no grooves to collect dirt. The smooth, unseamed surface and stainless steel top can be easily cleaned.

Inside the dispenser is black. vitreous-fired porcelain which is said to facilitate the movement of the cleaning compound as it is released. Constructed

Turco Handisan dispenser

with a sloping inner surface, the compound is always directed toward the actuator. This prevents plugging of the mechanism by the compound. Slight upward pressure on the actuator releases just enough Handisan for one hand washing. The entire top of the dispenser is hinged and raises for refilling. A concealed locking device prevents tampering.

A PRECISION profile grinding machine, identified as Type PSM and manufactured by Fritz Studer, Ltd., Glockenthal-Thun, Switzerland, is distributed in the United States by Cosa Corp., 405 Lexington Ave., New York, N. Y. It is used for grinding profiles of hardened work pieces such as profile gages,



Studebaker profile grinding machine

form tools, sectional dies, etc. Flat work pieces up to two-in. thickness and 5.9-in. length, and circular work pieces up to four-in. diameter can be handled. Precision is said to be ±0.0002 in.

Operation consists of the following a template, enlarged in suitable proportion, by means of a tracer finger swivelling about its point. Linear movements are transmitted to the grinding wheel head through the pantograph and swivelling movements by turning the wheel about its cutting edge through link bars. The wheel must be shaped proportionately to the exact shape of the tracer finger point and in the same ratio as template to work piece.

The pantograph can be adjusted to any ratio required. The accurate forming of the wheel to the shape of the tracer finger point is effected by moving the latter along the edge of a hinged guide bar on the template table, which can be turned down for the purpose. In holding the tracer finger at all angles during this operation, the movements are reproduced by the wheel contacting a diamond, which is brought in line with the extended swivel axis of the wheel head by means of a dial indicator.

Diamond holder and work piece are both fixed on a revolving table mounted on the vertical slide and can each in turn be placed opposite the grinding wheel. The stroke of the vertical slide can be set from 0 to 2.44 in.

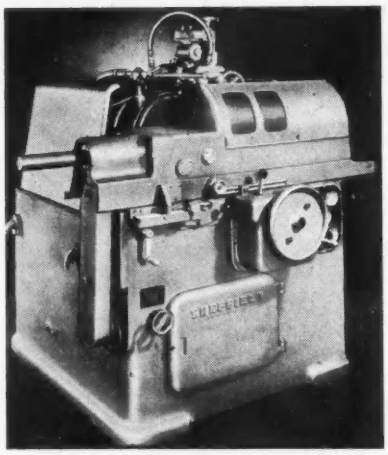
For the grinding of clearance angles of a form tool, the latter is fixed on an inclinable work piece rest, which is inclined to the required angle and the template table is tilted to the same angle.

Diamond wheels may be used for grinding tungsten carbide. A special device is provided for dressing these wheels.

A PRECISION annular form grinder has been brought out by the Sheffield Corp., 721 Springfield St., Dayton, Ohio. This new machine utilizes the "Crushtrue" principle of wheel dressing for the production of annular and cylindrical forms such as circular form tools, crusher rolls, ball bearing seals, seaming rolls, shift grooves in automotive transmission gears, and other similar forms of intricate and precise profile.

The new machine tool is similar in some respects to the Sheffield thread and form grinder, Model 101, which has been on the market for several years. This is true of the base, work table, wheel head, wheel feeding mechanism, and semi-automatic crushtruing device. However, the work head and work head drive are completely new.

A variable speed geared-head motor drives the work head spindle in either direction through pulleys and two V-belts over a spline shaft required for table positioning. The work head spindle may be of either live or dead center construction. The live center has provision for manual collet closing,



Sheffield precision annular form grinder

maximum collet size 0.6875 in. Standard work speed range is 60 to 360 rpm and may be varied in infinite increments. Additional work speeds, either higher or lower, can be arranged if desired.

A hand crank engages with the lead screw and is used for table positioning. The fine adjustment knob provides micrometer control of the table position, and a table lock prevents any shifting of work with respect to the wheel during the work cycle. A precision spacing attachment, using the standard gage blocks and dial indicator, is available as an accessory.

HYDRAULIC MACHINERY, INC., 12825 Ford Rd., Dearborn, Mich., has added to its line a fully-hydraulic, self-contained Hy-Mac pressure die casting machine identified as Model M-114. Suitable for handling zinc, aluminum and brass alloys, the new machine is furnished with the following equipment: Heating unit for metal; electric motor; valves for water lines; oil pump unit; filters or strainers in lines where necessary; and shut-off valves at important places in oil and water lines. A simplified arrangement for installation of the plunger without bolts or other loose parts and an improved gooseneck design are said to account for long life and eliminate sticking plungers.

Oil, electric and other lines are enclosed but are readily accessible. Safety arrangements are included for operating valves and shot cylinder. The flow of water through all water lines is visible to the operator. A deoxidizer, which is standard equipment on zinc alloy machines, reduces dross to a minimum.

A complete unit, with the cold chamber arrangement into which the metal is ladled, is available for high pressure die casting of aluminum and brass alloys. The die casting machine is so constructed that in a very few hours the "hot", or furnace, end can be interchanged for either zinc or aluminum and brass alloy production.

A MACHINE designed to dry loaded racks continuously before or after plating, or after any other type of water-solution dip, has been introduced by the Optimus Equipment Co., 269 Church Street, Matawan, N. J.

The machine is continuous in its operation, and works almost completely closed. It can be connected to an exhaust blower, so that all fumes will be drawn off. Any heating system—steam, gas, or electricity—can be employed.

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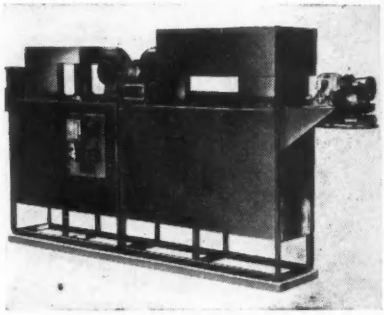
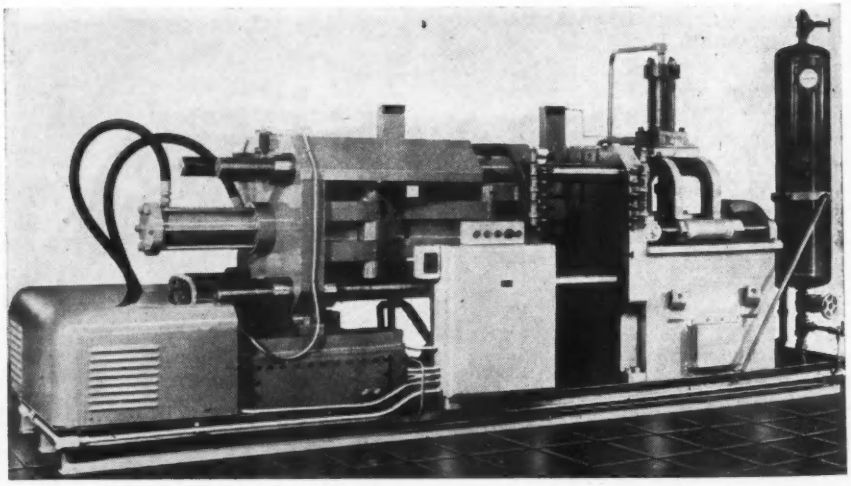
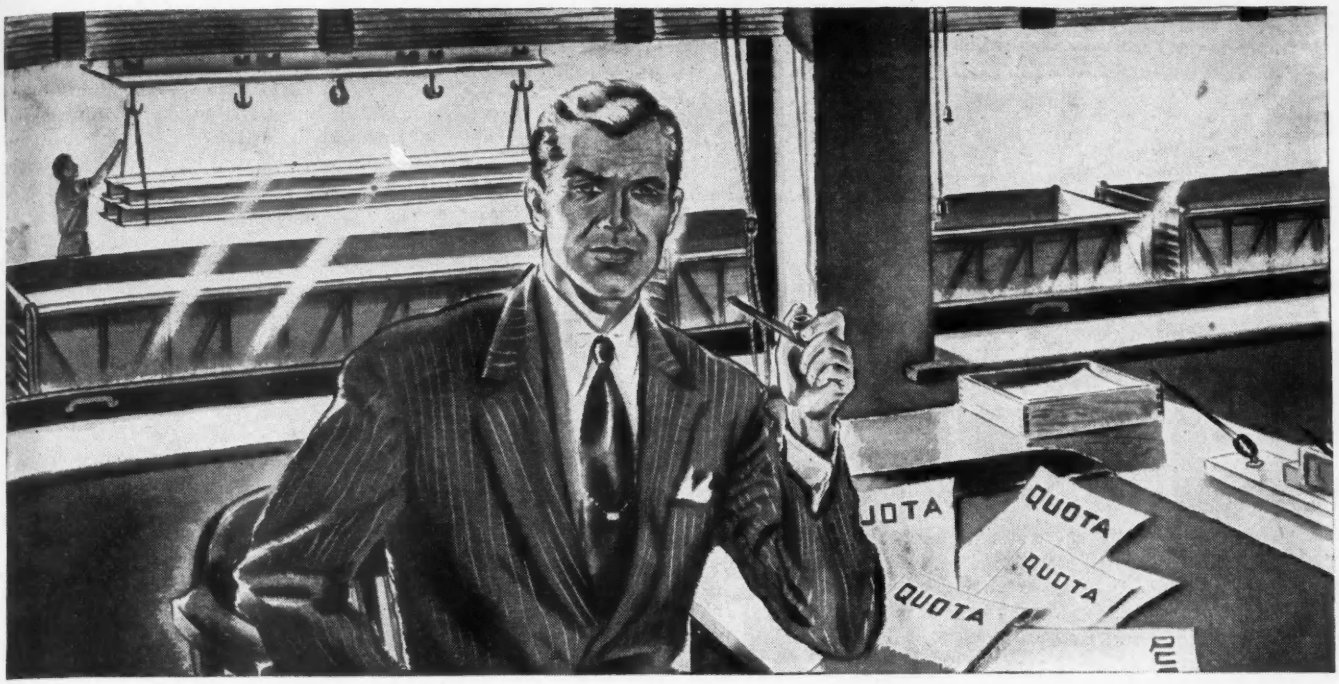


Optimus continuous type cold and hot air drying machine



Hy-Mac model M-114 die casting machine



We Don't Like "Quotas" Either

There are times when steel buyers must be on the verge of going berserk at the sound of the word "quota." We don't like quotas either . . .

But we have no choice, there just isn't enough steel to go around and we want to be fair with all of our customers.

We look forward to the time when *you*, the steel buyer, will tell *us* how much you will buy and we can strive to earn a large share of your tonnage.

In the meantime, while maintaining Inland quality and service at their usual high levels, we pride ourselves on an additional factor.

WE HAVE KEPT OUR WORD! . . . and, subject only to interferences beyond our control (strikes, etc.), we have made good. The commitments we have given our customers have justified their faith in INLAND as a RELIABLE SOURCE.

SELL YOUR SCRAP NOW!
More scrap is needed to make the steel so desperately needed by American industry.

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SHEETS • STRIP • TIN PLATE • FLOOR PLATE • PILING
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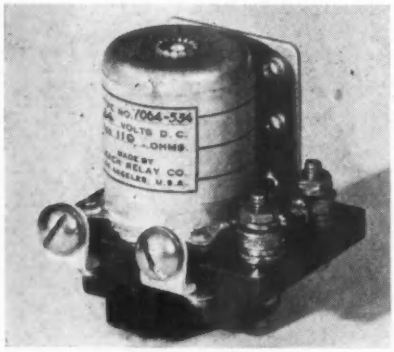
New Products for Aircraft

Lightweight Relay for Small Aircraft

Designed for feeder type planes and small personal aircraft, a new lightweight relay, capable of operating at altitudes up to 50,000 ft and at temperatures between 54 C and 71 C, is now available at Leach Relay Co., 5915 Avalon Blvd., Los Angeles, Calif. This relay is protected against damaging action of humidity, sand, dust and salt spray and will meet operating conditions up to 10G vibration and acceleration.

Designated type No. 7064-534, the relay is supplied with intermittent duty coils for motor starting applications.



Leach lightweight relay

Type No. 7064-534 C has duty coils for battery switching, motor control, aircraft and marine radio switching and lighting.

Contacts are made of special silver alloy, are ⅜ in. diameter, and rated at 100 amp at 12 volts direct current or 75 amp at 24 volts direct current. Contact arrangement is SPST, double break, normally open. Dependent upon the voltage and operating requirements, the coils have a resistance of from 9.5 ohms to 110 ohms. Coils consume approximately 15.12 watts on intermittent duty and 5.23 watts for continuous duty. Each relay weighs approximately 8½ oz.

Self-Adjusting Brakes for Heavier Loads

The dividing line between pedal control requiring normal physical effort to actuate aircraft brakes and the addition of power can be increased with the application of the automatic self-adjusting feature, which is available on the segmented rotor type airplane brake manufactured by the Bendix Products Division, Bendix Aviation Corp., South Bend, Ind.

In approaching this problem on the heavier type aircraft; when the brakes are applied, the amount of pressure on the foot pedal varies with the amount of braking effort required, but pedal travel changes as the lining wears and this makes periodic adjustments necessary. The ability to apply force is naturally limited by the range of brake pedal travel. If kept at a minimum by adjustment, manual or automatic, the increased efficiency results in a braking system that is capable of controlling heavier brake loads.

It is said that the Bendix self-adjusting feature available on the segmented rotor airplane brake will, as the lining wears, automatically keep pedal travel at a minimum. This eliminates the need of periodic adjustment to compensate for lining wear.

The increased efficiency of this type brake allows a reduction in weight and simplifies the braking systems on the larger types of airplanes, because auxiliary power for brake application can be reduced in amount or entirely eliminated.

Fatigue Relief Pilot

A light, compact automatic flight control system, weighing only 27 lb, designed by Lear, Inc., 110 N. Ionia Ave., N.W., Grand Rapids, Mich., in cooperation with the Control Equipment Branch, Equipment Laboratory of the U. S. Army Air Forces, Engineering Division, Air Materiel Command, has been under flight test at Wright Field, Dayton, Ohio.

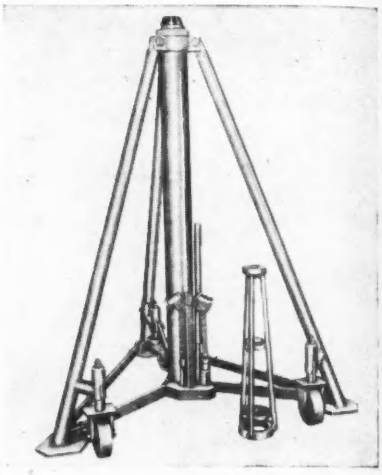
Originally developed for fighter aircraft, the C-2 Fatigue Relief Pilot is said to be equally capable of operating heavier aircraft. Being all electric, it is easily interconnected with other control devices such as used for altitude control, instrument landing and radio homing. It operates from a 24-28 volt system with an extremely low battery drain.

The Lear C-2 requires only three working units: A controller, located on or near the instrument panel; a control unit or amplifier, which contains both the vertical and directional gyroscopes; and a triple output friction drive servo-unit directly controlling the cables operating the airplane's ailerons, rudder, and elevators.

Hydraulically-Operated 10-Ton Aerojack

An all-purpose, hydraulically-operated, 10-ton Aerojack, with a working height of from 56 to 112 in., is introduced by the Airquipment Co., Burbank, Calif.

The new Aerojack is constructed of light weight steel tubing. The tripod

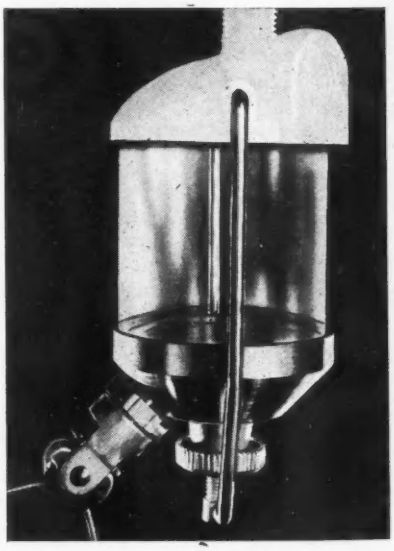


Aerojack made by Airquipment Co.

legs are supported by spring loaded casters for easy mobility. In operation, these casters retract when load pressure reaches approximately 1000 pounds, thus setting the jack squarely on the ground.

(*Turn to page* 50, *please*)

Easy-Drain Bowl for Fuel Filter

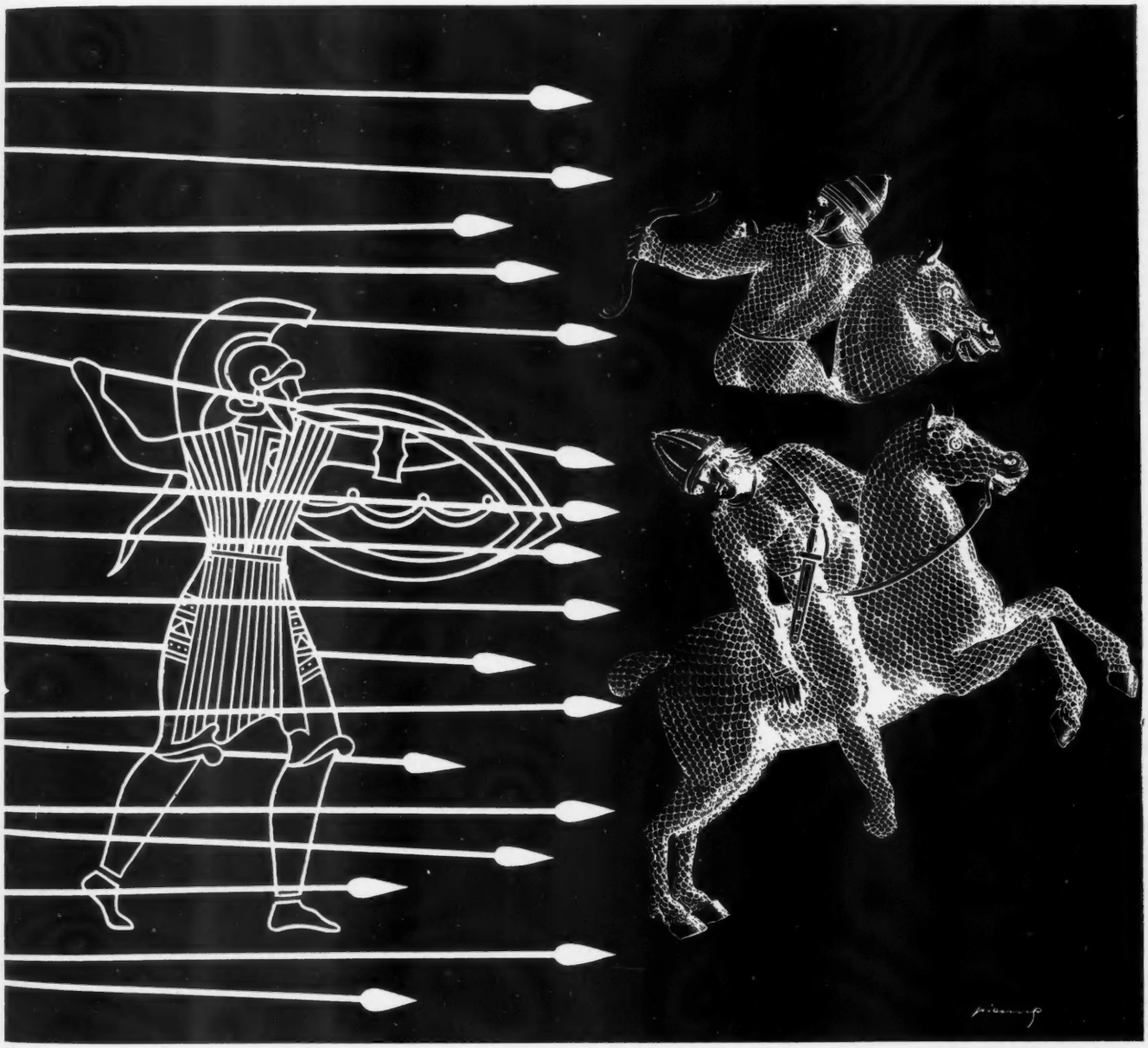


This transparent, easy-drain gascolator bowl is now being produced by Consolidair, Inc., Alliance, Ohio. Approved by the CAA, the new bowl consists of a transparent Pyrex glass bowl with a metal base and a poppet-type drain valve which permits the draining off of sediment without removing the bowl. It fits all light airplanes, and can be installed without tools.

THE MACEDONIAN SURPRISE PARTY

When the proud Persian hordes plunged headlong at Philip of Macedon's army, they were dumped into the minor leagues by an entirely new strategy, the phalanx: a solid wall of warriors sixteen ranks deep. Strength-in-depth withstood and defeated the impact of an over-confident enemy.

Molybdenum steels are economical means of getting the strength-in-depth called hardenability. With it, you're assured of dependable performance under severe service conditions. Practical facts are available to show you where molybdenum can go to work for you.



MOLYBDIC OXIDE—BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"
CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

Climax Molybdenum Company
500 Fifth Avenue • New York City

MOLY

Maximum lift height of basic unit is 95 in., which can be increased to 112 in. by use of component high adaptor cap. Grooved drive pins permit assembly and disassembly. The ram movement is powered by a manually-operated hydraulic pump.

Lightweight Wire for Use in Aircraft

A new aircraft wire, known as Neolay, which is said to reduce the fire hazard and lighten the weight of planes is announced by United States Rubber Co. The product is 30 per cent lighter than conventional electrical wire. Its flameproof insulation consists of a layer of glass fiber, to insure circuit integrity, and a fire-resistant synthetic rubber applied by a special dipping process developed by the company. The overall diameter is 15 per cent smaller than conventional aircraft wire.

The new wire is highly resistant to oil, chemicals, mildew and fungus.

New Double Wasp Engine

A new and more powerful model of the Double Wasp engine manufactured by the Pratt & Whitney Division of United Aircraft Corp., 400 Main St., East Hartford 8, Conn., has entered the commercial field. Known as the "CA" model, the new 2400-hp engine succeeds the Double Wasp engines heretofore used only by the military forces. The "CA" Double Wasp is being used to power the four-engined Douglas DC-6, the two-engined Martin Models 202 and 303, and the two-engined Consolidated Vultee Model 240.

The 'CA" Double Wasp is said to be the first engine to receive an approved type certificate from the Civil Aeronautics Administration for the use of water injection to provide additional power in commercial operations. Provision is made in all "CA" series engines for the use of water injection, if desired, to deliver 2400 takeoff hp.

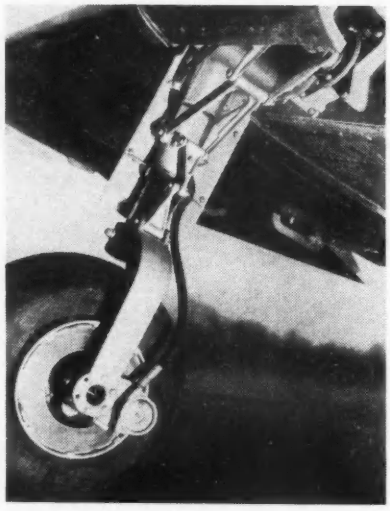
The dry weight of "CA" Double Wasp engines, from 2327 to 2360 lb, puts them in the one-lb-per-hp class. The weight includes such standard equipment as the carburetor, carburetor air screen, radio shielded ignition system, spark plugs, pressure type cooling deflectors, primer tubing and distributor, torquemeter, and provision for a feathering and reversible pitch hydraulic propeller.

There are four models of the "CA" engine now available for commercial applications, all of them with single-stage, built-in superchargers. Two models, the CA3 and the CA5, have single-speed superchargers, suitable for low altitude air transport operations or for use with an exhaust driven supercharger for extreme altitudes. The other two models, the CA15 and the CA17, have two-speed supercharger drives for effective operation at altitudes up to more than 20,000 ft. The CA15 model has approved ratings for takeoffs using the high-speed drive. This improves takeoffs from airports situated at high altitudes.

Power ratings, without water injection, of the CA3 and CA15 models are based on the use of 100/130 grade fuel: 2100 hp for takeoff and 1800 hp for continuous operation. The ratings of the CA5 and CA17 engines, with carburetor modification and with 115/145 grade fuel, have been certificated at 2300 hp for takeoff and 1900 hp for continuous operation, using the low-speed supercharger drive in the case of the CA17 engine.

Hydraulic Landing Gear for Lightweight Planes

This hydraulic main landing gear strut No. 16045 for light aircraft, which is manufactured by Adel Precision Products Corp., 10777 Van Owen St. Burbank, Cal., is now in use on the Globe Swift.



The Adel hydraulic landing gear

It is designed to take a limit load factor of 4.33 on a 1750-lb airplane. When fully extended, it has a length of 25¾ in. between pivot and axle centers. The wheels mount a standard 6.00 x 6 aircraft tire.

Jacobs Announces New Opposed Engines

New opposed aircraft engines in both aircooled and liquid cooled models are announced by the Jacobs Aircraft Engine Co., Pottstown, Pa.

Rated at 165 hp with a 360 cu-in. displacement, the new aircooled six cyl engine will feature reverse cooling and fuel injection. A 100 hp four-cyl engine with 240 cu-in. displacement will also be offered.

These engines, as well as a line of new liquid cooled opposed engines, are designed to meet the demands of aircraft manufacturers for small engines to power the larger new light planes.

The liquid cooled models, both six and four cyl, are available at the same horsepower ratings and displacement as the two aircooled models. They have been developed especially for pusher use, for submerged installations in fuselage or wing, and for seaplane or amphibian aircraft where taxiing loads put extreme demands on engine cooling capacity.

Head Phone Cushion of Heat-Conducting Rubber

This "air-cooled" head phone cushion is made of molded, heat-conducting rubber by the Aviometer Corp., 370 W. 35th St., New York, N. Y. It brings to pilots and other aviation personnel the benefits of a new development in synthetic rubber.

Aircraft Instrument Oil

An aircraft instrument oil, designed for gyro instrument service in aircraft, has been brought out by The Texas Co. It meets the requirements of Army-Navy Aeronautical Specification AN-0-6a.

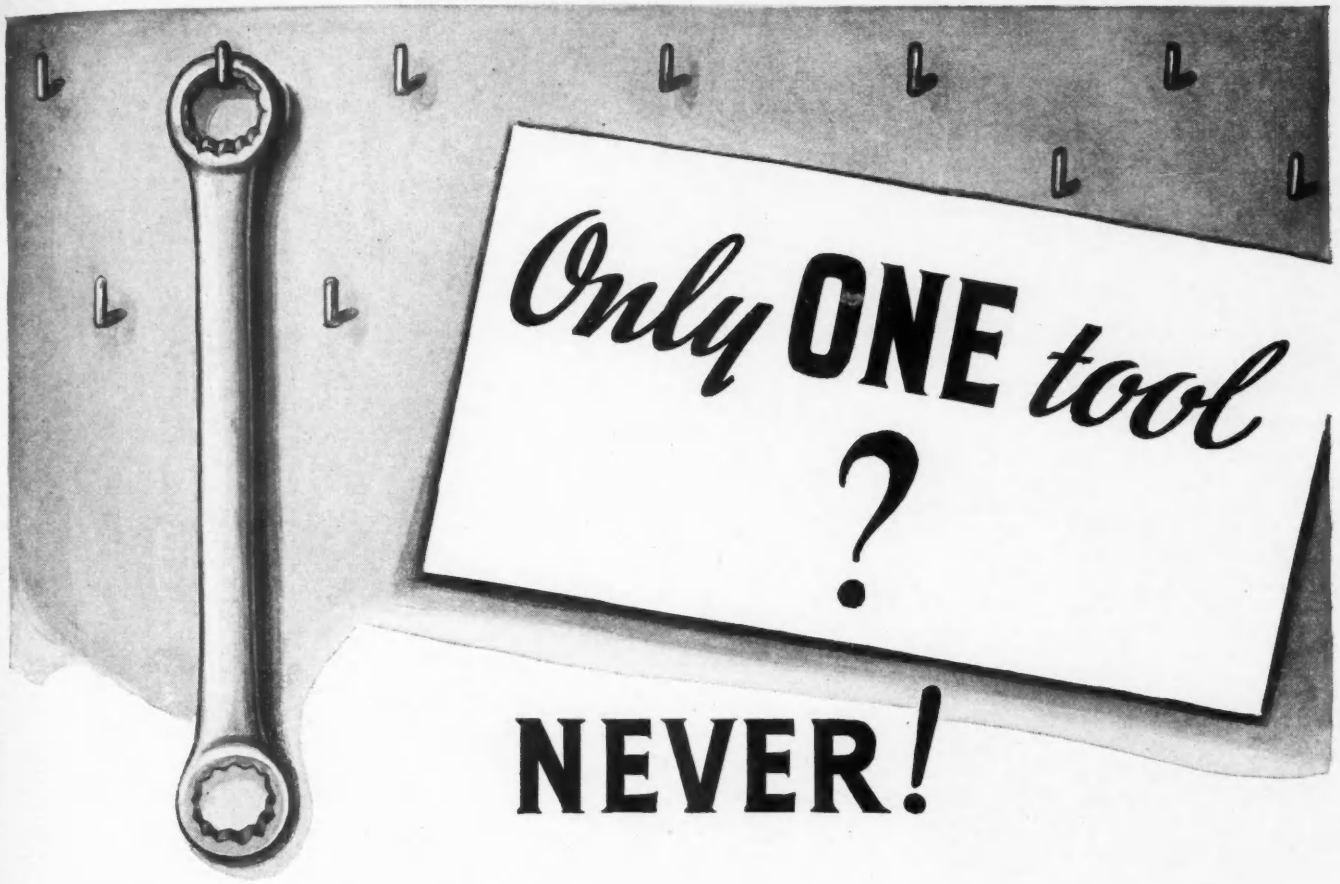
Texaco Develops New Aircraft Starter Grease

The new Texaco aircraft starter grease containing graphite, developed by The Texas Co., 135 E. 42 St., New York, N. Y., is said to add to the good qualities of former starter greases a high resistance to softening on repeated workings and excellent low temperature properties.

Ford Awards Contract For Production Equipment

The Ford Motor Co. has awarded a contract to F. H. McGraw & Co., for the purchase and installation of new production equipment in the Ford assembly plant being built at St. Louis.

This contract, totaling over $3 million, marks a departure in the policy of the Ford Motor Co. It is the first time that Ford has contracted under a single contract for the purchase and installation of all the equipment for a complete assembly plant. Heretofore, such work has been regularly handled within the company.



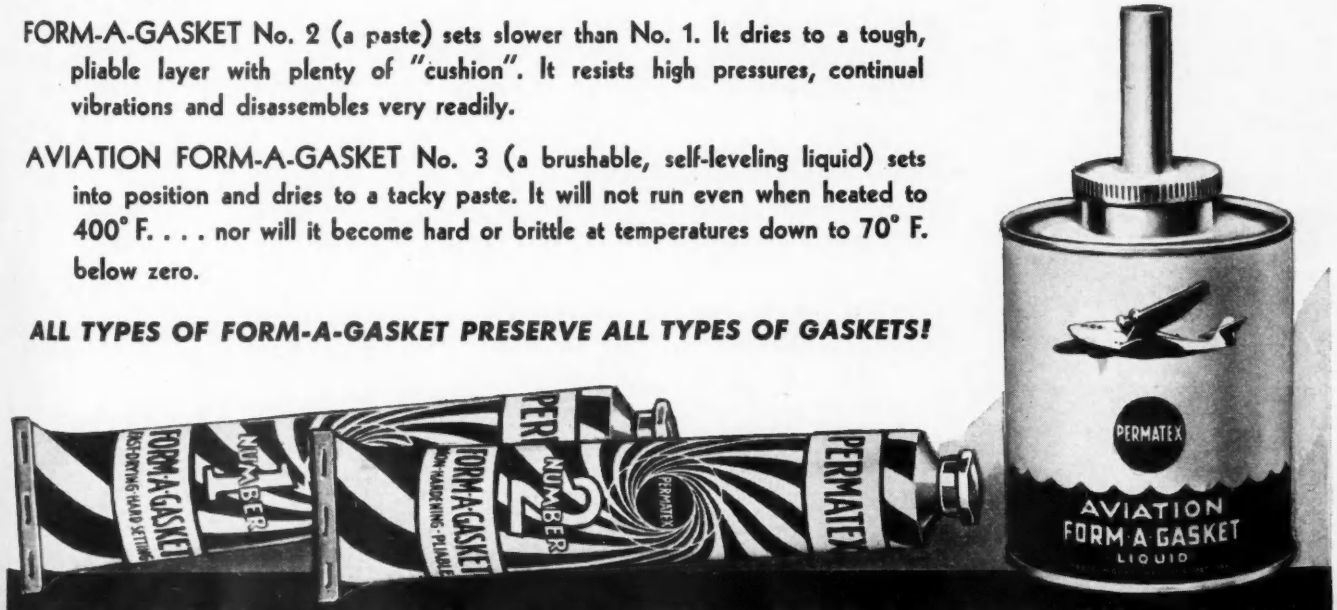
YOUR SHOP is equipped with the right tools for ALL jobs. **PERMATEX FORM-A-GASKETS** are just like tools . . . each one does certain kinds of work better than the others!

FORM-A-GASKET No. 1 (a paste) sets fast but not too fast for use on large surfaces. It dries hard but does not become brittle. It's a swell product for making pressure-tight, leak-proof, permanent unions . . . . even when surfaces are warped.

FORM-A-GASKET No. 2 (a paste) sets slower than No. 1. It dries to a tough, pliable layer with plenty of "cushion". It resists high pressures, continual vibrations and disassembles very readily.

AVIATION FORM-A-GASKET No. 3 (a brushable, self-leveling liquid) sets into position and dries to a tacky paste. It will not run even when heated to 400° F. . . . nor will it become hard or brittle at temperatures down to 70° F. below zero.

ALL TYPES OF FORM-A-GASKET PRESERVE ALL TYPES OF GASKETS!

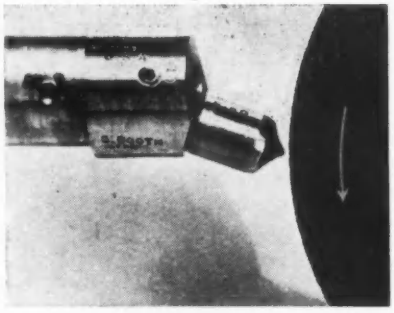


PERMATEX COMPANY, INC., BROOKLYN 29, N. Y.

New Products

Three-Angle Turret Diamond Holder

Diamond Tool Co., 938 E. 41 St., Chicago 15, Ill., has developed an automatic, self-centering, turret diamond holder which, when used either in the adapter of a center grinder or Diamond Tool Company's magnetic block on a surface grinder, enables the operator to secure the utmost in use from the

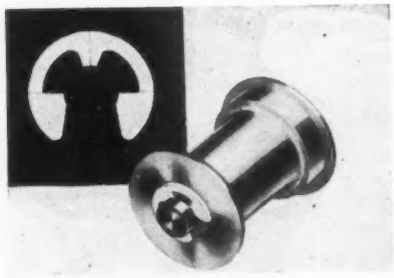


Sheldon Booth turret diamond holder

diamond. A range of three angles—30 deg, 20 deg and 10 deg—is provided, and the mechanical action of the turret holder automatically centers the diamond point in each of the angles directly at the point of grind on the grinding wheel. The new device, identified as the Sheldon Booth automatic, self-centering turret diamond holder, is licensed only for use with "Re-Set-Able" diamond tools manufactured by the Diamond Tool Co.

Truarc Type "E" Retaining Ring

A new E-shaped retaining ring for small shafts is offered by the Truarc Sales Division of Waldes Kohinoor, Inc., 47-10 Austel Place, Long Island City 1, N. Y. Providing an unusually



Truarc retaining ring

large and uniformly protruding shoulder on shafts of 3/32 in. diameter and over, this new ring sprung into a comparatively deep groove is designed to withstand considerable thrust loads.

Three protrusions, equally spaced, form the abutments in the groove of the shaft. Recesses between the protrusions make the ring sufficiently resilient to permit the necessary spread for easy, quick assembly and disassembly without permanent set.

Installed in a radial direction and requiring no special tools, the E ring is said to be ideally suited for application where a shaft is inaccessible in a longitudinal direction.

New Method of Processing High Speed Steel

The Jessop Steel Co., Washington, Pa., announces in collaboration with the Barium Steel and Forge Co., Inc., Canton, Ohio, a new method of processing high speed steel rounds in diameters greater than four in. The new process is known as Vee-Oginizing.

Jessop Vee-Oginized high speed steel rounds in the larger diameters are said to be free from the usual central carbide segregation that is common to high speed steels as usually processed. Vee-Oginized high speed steel assures a uniform carbide distribution throughout and eliminates the brittle carbide pattern found in large rounds of high speed steels processed by conventional methods.

Aluminum Alloy Keys

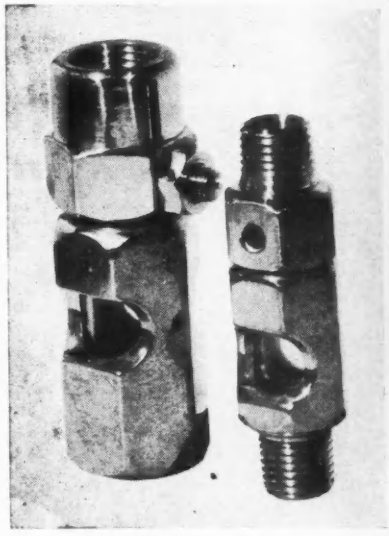
Featherweight automobile keys made of a special aluminum alloy are now in large-scale production at the Stamford Division of The Yale & Towne Manufacturing Co., 200 Henry St., Stamford, Conn., and will be in wide distribution soon as part of the standard equipment of 1947 model cars.

All new automotive replacement locks now being introduced by the company to the automotive trade are furnished with Yale aluminum alloy keys.

Sight Feed Valve for Circulating Oil Systems

A new sight feed valve for circulating oil systems or multiple oiler arrangements for feeding a number of bearings has been brought out by Oil-Rite Corp., 3426 S. 13 St., Milwaukee 7, Wis. It permits visual checking and regulation of the oil flow.

In operation, oil flows past an adjustable port through a valve nozzle into



Oil-Rite sight feed valve

the sight chamber where the amount of flow can be observed. The flow through the port can be adjusted through a wide range by the combination of a set screw and a hollow lock screw.

Oil-Rite sight feed valves are available with hexagon bodies of ¾, 15/16, 1⅛ and 1 5/16 in., and pipe threads of ⅛, ¼, ⅜ and ½ in.

Reading Recorder for Profilometer

For those who need a written record of the surface roughness measurement of a part, the new Profilometer reading recorder has recently been developed. Operating as an attachment to the Profilometer made by Physicists Research Co., 321 S. Main St., Ann Arbor, Mich., the reading recorder provides a continuous chart record of the average roughness of the surface being measured.

The charts, which are read in microinches, are useful in obtaining more detailed information on surface rough-

Profilometer reading recorder

ness, such as the location of rougher or smoother areas, and in supplying customers with records of the surface

(*Turn to page* 96, *please*)

DESIGNING FOR DIE CASTING

Send for ➡ your copy

INSERTS

In designing die castings, inserts should be employed whenever their use achieves results that cannot be realized at equal cost by other means. Cast inserts are generally used for one or more of the following reasons:

1. *To provide greater strength, hardness, wear resistance or ductility, or to obtain magnetic and other special properties not possessed by the casting itself.*
2. *To provide passages or shapes of parts which cannot be cored or cast, or which can be obtained more economically with inserts.*
3. *To effect an assembly not so readily or so inexpensively achieved by other means.*

Seven assorted inserts are accurately positioned and bound together in the zinc alloy die cast generator housing shown here. The inserts (grouped above) are: four soft steel pole pieces; an aluminum-nickel-cobalt magnetic disk; a bronze bushing; a steel support stud. In the casting operation a zinc alloy housing is formed around the seven inserts, bringing them into a one-piece unit.

Non-metallic inserts which frequently have been cast in die castings include cloth, fibre, compressed paper, porcelain, wood and plastics.

There are a number of points to be considered by the designer when inserts are to be employed in die castings. These and other design considerations are covered in our booklet "Designing for Die Casting." To insure that you will get the most from your die casting dollar, ask us—or your die casting source—for a free copy of this booklet.

ZINC
FOR DIE CASTING ALLOYS

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The Research was done, the Alloys were developed, and most Die Castings are based on HORSE HEAD SPECIAL (99.99 + % Uniform Quality) ZINC

NEWS *of the* Industry

Production Figures at Postwar High During August . . . Chrysler Corporation Faces Another Battle with Union . . . Reuther Still Wants "Wages Up, Prices Down" . . . Model Changes Due Late this Year or Early in 1947 . . . Building Projects Delayed by Restrictions . . . Workers at Nash Strike for New Cars for Employes.

Automobile weekly production figures showed some new postwar highs during August and when the production total for the month is compiled will show a definite gain over July. However, encouraging as it may be to see an upward trend, the gain will be disappointing when viewed in the light of projections made early last month.. It is estimated that U. S. manufacturers will show a total output of about 350,000 cars and trucks, a gain of approximately 36,000 for the month. Estimates early in August, however, had indicated that production might top the 400,000 mark very handily. That it failed to come even close to that level shows clearly once again that the industry still is in the grip of paralytic shortages and labor trouble.

The failure to come any closer to projected schedules was due in part also to the complete suspension of all Chrysler Corp. assembly lines during the last week of the month because of material shortages, and the strike at Nash which choked off assembly for the last three days. Critical materials, such as copper, lead, pig iron, and steel, still are very short, and it is an open question whether the industry can make any appreciable gain in September over August. Estimates now being made contemplate a continued upturn, but there are many reservations attached. M. E. Coyle, executive vice-president of General Motors said recently that unless the Corporation can prevail on the government to release some of its reserve of copper and lead, there is grave doubt that General Motors can even maintain its present levels of production.

Union Opens Wage Fight With Chrysler Corporation

Prodded by dissident local factions at Chrysler Corporation, the UAW-CIO has fired the first round in a new battle for wage increases in the automobile manufacturing industry under the somewhat less odious tag of "cost of living bonuses." Under the terms of the contract, wages can be re-opened after 60 days' notice by either party. No specific demands were made by the union, so the extent of increases to be sought is not known. The union said it would study the trend of prices during the 60-day waiting period and act accordingly when wage talks are opened. In its reply, the corporation hinted that it would resist strongly any further increases at this time, but stated that it would comply with the terms of the contract and discuss the issue. In a letter to the union, Chrysler stated: "In our meetings with you we repeatedly tried to get the Union's representatives to see that their demands would lead inevitably to higher prices. We tried to persuade you that higher wages do not mean high purchasing power. The way to more purchasing power is through producing more. The best curb on prices is the competition for buyers resulting from a high production of goods for sale.

"If we could obtain . . . the free flow of materials necessary . . . and employes would attend to their work regularly, our employes would increase their earnings through more regular work and output of automobiles. As you know, earnings of employes have been lower than they ought to have been because of strikes. Fifty unauthorized strikes occurred in our plants between last June 6 and Aug. 21. All these strikes violated your Union's contract with Chrysler and none need have taken place if the men involved had complied with the bargaining procedure under the contract.

"We do not believe there should be another round of wage increases at this time or another round of strikes. We hope your Union will consider further and avoid the mistake time has shown it made at the end of the war."

There is little hope, of course, based on past performance that the union will respond to any approach based on reason or economics. Because of the intense political factionalism prevalent in the union today, such a course is almost impossible. It now appears that a strike at Chyrsler is still a long way off, if it comes at all. Wage talks cannot begin until Oct. 20 at the earliest and negotiations can be extended over a considerable period. The union will most likely stall its members along until at least after the November elections in order to avoid repercussions at the polls upon its candidates.

"Wages Up, Prices Down" Theory Still Not Dead

Walter Reuther, UAW-CIO president, whose theory that wages could be boosted without a corresponding increase in prices has been pretty thoroughly discredited in the past few months, apparently remains of the same opinion still, at least for political purposes. Writing in *The Auto Worker*, August issue, he lists as the first of his basic principles for keeping wages rising faster than the cost of living the following: "First, we must try to get all American labor to join us in the fight to win wage increases without price increases." Just how he proposes to accomplish this objective is not explained. Under provisions of the Barkley amendment in the new OPA law, manufacturers can recover increased costs of wages, so unless Reuther can persuade them to refrain voluntarily from increasing prices, his principle is good political double talk and nothing more.

Signs Point to Model Change In Late '46 or Early '47

By piecing together random bits of evidence, it now appears that changeover to 1947 models by most companies will come either late this year or early in 1947. From the amount of work in die shops it appears that the changes will be relatively minor ones, mostly confined to grille and body treatment, with very little in the way of mechanical variations from the current models. The period of shutdown for the changeover also will be very brief, probably extending to closing down press shops long enough to install new dies in the presses and to get the new parts flowing into the assembly lines. With the present seller's market still expected to be going strong, the manufacturers apparently are going to make just enough styling changes to justify the "new-model" designation, but will hold off the major mechanical improvements until '48 models come out, probably sometime next Fall, when the market may require something really new and different to maintain its sales momentum against the force of high

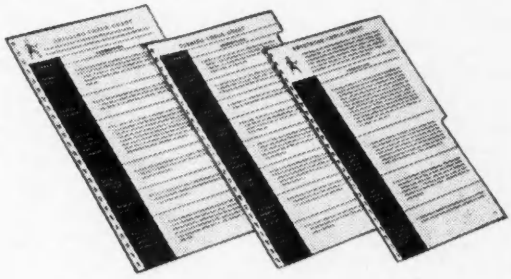
(*Turn to page* 60, *please*)

NOW.. complete information to help you MACHINE STAINLESS STEEL AT LESS COST!

THIS NOTEBOOK contains pages and pages of useful information, much of it never before published! It gives many useful hints to take the kinks out of Stainless production jobs, reduce rejects and cut costs.

. . . In each chapter you'll find a complete Check Chart that lists common "trouble spots", and gives shop tips on how to cure them. On many jobs, a quick reference to the Check Chart will be your first step to saving man-hours on an operation.

LUBRICATION — *This one chapter alone will help you get longer tool life, higher speeds, better finishes.*



AND THIS 116-PAGE NOTEBOOK ALSO CONTAINS . . .

DETAILED SKETCHES ON TOOL GRINDING—Angles and clearances for all types of common tools are described, along with detailed working information and grinding, stoning, lubrication, etc.

TABLES OF SPEEDS AND FEEDS—Whatever your production job—Turning, Drilling, Threading, etc.—turn to the Table of Recommended Speeds and Feeds for the type of Stainless you're using.

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To put this useful book to work on your own jobs, just get in touch with your nearby Carpenter representative. He will be glad to give personal copies of the NOTEBOOK to Production and Management Executives. And after you have it, if you want additional copies for the men in your plant, they can be secured at cost. Extra copies are available at 50c apiece.

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Publications Available

Publications listed in this department are obtainable by subscribers through the Editorial Department of Automotive *and* Aviation Industries. In making requests give title above the item concerning the publication desired, the date of issue in which it appeared, your name and address, company connection and title.

Weld Cleaning

Chicago Mfg. & Distributing Co.—16-page booklet, How to Clean Welds, covers all phases of weld cleaning and provides complete instructions on the subject for experienced welders as well as beginners.

Wheel Bearing Greases

The Texas Co.—A bulletin on lubrication of aircraft wheel bearings, containing charts, diagrams, photographs and text to provide maintenance personnel with information on wheel bearing greases and their proper application.

Ingersoll Cutters

The Ingersoll Milling Machine Co.—Catalog No. 55 lists in detail standard inserted blade cutters made by Ingersoll and illustrates many possible special and deviations from standard.

MagniLastic Expansion Joints.

Cook Electric Co.—Newly revised and enlarged bulletin describing the MagniLastic Packless Type Expansion Joint, lists complete engineering data, dimensional tables and specifications for the MagniLastic line of expansion joints, anchor joints and low pressure large diameter expansion joints. Information is also given on the offset, turbo and jacket joints and high temperature exhaust bellows. Catalog number is 226M.

Carbon Dioxide Protection

Randolph Laboratories, Inc.—20-page booklet entitled How to Fight Fires and Protect Property explains and illustrates the latest techniques in fighting fires with carbon dioxide and other type fire extinguishers.

Rosin Rubber

Hercules Powder Co. — Booklet entitled Rosin Rubber describes the chemical composition and properties of Dresinate 731, the advantages of GR-S-10, the first rosin rubber, over GR-S recipes utilizing fatty acid soaps.

Hydraulics

Hydro-Power, Inc.—Bulletin No. 460, on Hydro-Power, contains detailed information and basic specifications of the complete line of hydraulic high pressure pumps, valves, controls, boosters and packages hydraulic power units made by Hydro-Power, Inc.

Filters

Drico Industrial Corp. — Booklet on the underlying principles of efficient filtration and its necessity, with an explanation of the Vokes principles and their applications.

Uni-Matic Lathe

Monarch Machine Tool Co.—36-page booklet, No. 1701, describes and illustrates the new Uni-Matic lathe, a new postwar automatic turning machine. Photographs are used to illustrate the versatility of maching set-ups possible with the Uni-Mats—individually motor-operated tool slides — with which the new turning machine is equipped. Several pages are devoted to the electrical features and timing devices incorporated in the lathe to permit the efficient machining of parts at high speed.

Turbo-Blowers

Allis-Chalmers Mfg. Co.—The A-B-C of Allis-Chalmers turbo-blowers, rotary compressors and vacuum pumps is explained in a 16-page booklet designed for student training which tells what these units are, how they operate and how to figure them. The booklet is attractively illustrated; curves are reproduced depicting pressure volume, influence of water vapour on volume and correction curves for volumes to maintain constant air weight with changes in temperature and barometric pressure.

Heavy Duty Transmissions

Fuller Manufacturing Co. — Booklet covering factors to be considered in selecting the proper transmission to be used with trucks of various sizes and horse-power capacities. The booklet is illustrated and describes the complete line of Fuller Transmissions and Auxiliaries for heavy-duty applications. It lists reduction ratios for each model and combination and gives important features of design and construction.

The Dynamic Budget

McClure, Hadden & Ortman, Inc.—A booklet, The Dynamic Budget, gives suggestions for reducing distribution costs. In addition to charts, the booklet contains six case studies of widely selected subjects to show application of the break-even chart to many of today's problems.

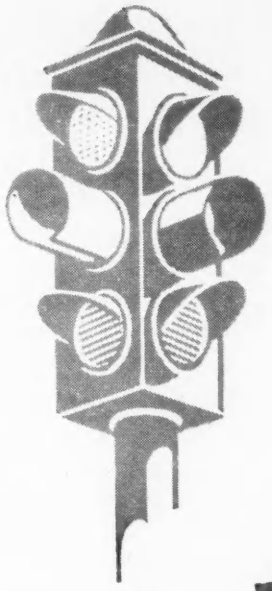
Weekly Production of Cars and Trucks in U.S. and Canada*

Week ending	1946	Corresponding Week in 1941
Jan. 5	13,920	76,690
12	23,340	115,935
19	28,465	124,025
26	29,410	121,948
Feb. 2	29,295	124,400
9	23,785	127,675
16	21,555	127,510
23	19,410	127,740
Mar. 2	17,575	126,550
9	23,050	125,915
16	35,020	131,410
23	37,285	123,805
30	43,070	124,165
Apr. 6	47,735	116,255
13	49,425	99,260
20	57,565	99,945
27	64,620	108,165
May 4	67,060	130,610
11	71,335	132,380
18	48,565	127,255
25	53,020	133,560
June 1	31,895	106,395
8	43,175	133,645
15	50,206	134,682
22	54,475	133,565
29	64,015	127,926
July 6	45,175	96,457
13	74,015	114,318
20	80,395	109,912
27	84,720	105,635
Aug. 3	79,385	62,146
10	77,825	41,795
16	88,990	45,550
23	91,360	45,525
30	73,305	39,965
Totals	1,701,461	3,775,239

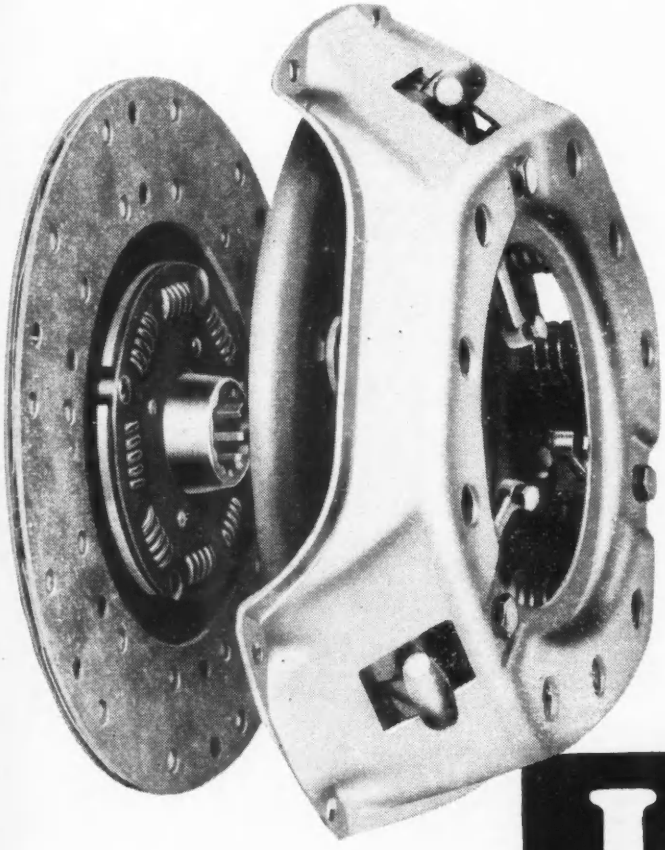
*Compiled by Ward's Automotive Reports.

First Twin-Engine Helicopter, the XHJD-1

Said to be not only the first twin-engine helicopter but also the world's largest, the XHJD-1 was built by the McDonnell Aircraft Corp. in collaboration with the Bureau of Aeronautics. In common with other helicopters, it takes off and lands vertically, hovers motionless, flies forward, sideways and backward. Two 450-hp Pratt & Whitney Wasp Jr., engines power the craft's two lifting rotors which are arranged side by side. The 40-ft. rotors turn in opposite directions, making a tail or torque rotor unnecessary. The span from rotor tip to rotor tip is 81 ft. The use of twin-engines is intended to give the XHJD-1 greater reliability. The helicopter will cruise at more than 100 mph with a useful load of over 3,000 lb. The Pratt & Whitney engines are mounted midway on the pylons extending from the fuselage out to the rotor hubs. Either engine is able to drive both rotors through a system of over-running clutches. Without power, the rotors will autorotate and the craft can glide to earth in somewhat the same manner as a fixed wing airplane.



Smooth!



Long clutches respond to easy pedal-pressure instantly, with effortless dependability. In stop-and-go traffic, that means smooth, positive acceleration—and less wear and tear on the nerves!

The Long semi-centrifugal clutch has greater torque capacity at increased speeds. Its easy, feather-light action is *smooth*—at any speed!

LONG MANUFACTURING DIVISION
BORG-WARNER CORPORATION
Detroit 12, and Windsor

LONG

CLUTCHES • RADIATORS • OIL COOLERS

PERSONALS

Recent Personnel Changes and Appointments at the Plants of Automotive and Aviation Manufacturers and Their Suppliers.

Ford Motor Co.—David W. Lee, Asst. Truck Sales Mgr.; **A. E. Vallier,** Asst. to Administrative Engineer, V. Y. Tallberg.

Graham-Paige Motors — D. Fraser Sullivan, elected member of the Board of Directors; **B. A. TePaske,** Asst. Director of Farm Sales.

White Motor Co. of Canada—L. M. Hart, Jr., named President, succeeding his father, L. M. Hart, retired.

Studebaker Corp. — Robert W. Wheeler, District Mgr., Buffalo Branch.

Marmon-Herrington Co., Inc.—Russell L. White, elected member of Board of Directors.

Gar Wood Industries, Inc.—Clifford A. Sharpe, Works Mgr.; **Robert L. Bartley,** Mgr., Tank Div.

Mack - International Motor Truck Corp.—John W. Adelung, District Mgr., White Plains New York branch.

The Baker-Taulang Co.—Douglas L. Darnell, Vice-Pres. in Charge of Sales.

Fairchild Engine and Airplane Corp., Fairchild Aircraft Div.—Brig. Gen. William W. Welsh, Technical Advisor to Richard S. Boutelle, General Mgr.

Sun Oil Co.—Dr. Eugene B. Nugent, Mgr. of newly inagurated Automotive Sales Engineering Div.

Borg-Warner Corp., Borg & Beck Div.—Harold Nutt, elected Vice-Pres. in charge of Engineering.

Nox-Rust Chemical Corp.—Ray D. Cunningham made Driector of Sales, and **W. F. Costello, Jr.,** made Eastern Sales Mgr. for government and marine sales.

Willard Storage Battery Co.—W. L. Tyler, Sales Mgr. for newly created Pacific Coast Region, and **E. D. Gray,** District Sales Mgr. of the Northwestern District.

Bendix - Westinghouse Automotive Airbrake Co.—H. B. Smith, appointed Regional Mgr. of Atlanta territory, succeeding the late E. W. McKay. **C. R. Mitchel,** Regional Mgr., Philadelphia.

Aircraft Screw Products Co., Inc.—John O. Forster, appointed Chief Engineer.

The Aro Equipment Corp., Air Tool Div.—E. L. Jackson and **M. J. Anderson,** appointed assistant sales managers.

Snyder Mfg. Co.—Dick Morris, General Sales Manager.

Butler Engineering Co. — Lloyd B. Poole, Director of Sales.

Kennametal, Inc., Bennett Burgoon, District Mgr., Central District, with headquarters in Detroit. **Thomas O'Connell,** Agent for South Atlantic District, with headquarters in Asheville, N. C.

Toledo Steel Products Co.—Carl L. Kahlert, Eastern Div. Sales Mgr., with headquarters in Toledo.

Insuline Corp. of America, Major Bernard L. Cahn, Executive Asst. in charge of sales and promotion activities.

Aetna-Standard Engineering Co.—A. L. Thurman, Asst. to Vice-Pres.; **James Riddell,** Chief Electrical Engineer.

Jessop Steel Co.—I. B. Anderson, Mgr. of Stainless Steel Div.

Firestone Tire and Rubber Co. of California—James J. Robson, Mgr. of West Coast Div., Manufacturers' Sales Dept.

Telephonics Corp.—Hugh E. Allen has been made Manager of Electronics Enginering and Sales.

Buick Completes First of New Construction Projects

Completion of the first of the major construction projects, launched in the post-war modernization and expansion program of the Buick Motor Division of General Motors Corp. last fall, was announced by Harlow H. Curtice, vice president of General Motors and chief executive of Buick.

The new building, having 252,000 sq ft of floor space and designed as a part of the company's final assembly area, provides modern facilities for manufacturing, sub-assembly, parts receiving and storage operations in connection with the final asembly of cars. It adjoins the hugh Buick assembly line where production has been carried on in increasing volume during the course of construction.

Construction of a dozen other buildings at Flint, Mich. including a large sheet metal plant, expanded foundry and forge facilities and shipping and storage structures, will provide another million sq ft of floor space for Buick operations. Previously Buick leased the Government-owned tank arsenal at Grand Blanc, Mich., as a parts warehouse and shipping department and purchased the aluminum foundry, built for the Government on Buick property during the war, for conversion into a machine shop. These added another 1,100,000 sq ft to Buick facilities.

New Passenger Car Registrations*

First Six Months 1946 and 1941 Compared.

	First Six Months		Per Cent of Total Six Months	
	1946	1941	1946	1941
Ford	107,923	332,542	21.88	15.61
Plymouth	74,845	364,771	15.17	12.44
Chevrolet	55,406	595,477	11.23	24.35
Dodge	49,423	133,884	9.82	5.59
Nash	32,824	54,033	6.65	2.21
Hudson	25,581	45,831	5.19	1.87
Chrysler	23,396	95,103	4.74	3.88
De Soto	22,474	57,746	4.56	2.36
Pontiac	21,260	194,944	4.31	7.96
Buick	17,496	209,915	3.55	8.57
Mercury	16,297	52,718	3.30	2.14
Oldsmobile	16,042	159,488	3.25	6.51
Studebaker	15,161	67,005	3.07	2.74
Packard	8,298	39,190	1.68	1.60
Cadillac	5,176	39,226	1.05	1.60
Lincoln	2,506	11,783	.51	.48
Crosley	14	311	.....	.02
All others	187	1,814	.04	.07
Total	493,309	2,449,241	100.00	100.00

* From R. L. Polk & Co.

New Truck Registrations*

	June 1946	May 1946	June 1941	Six Months		Per Cent Change	Per Cent of Total Six Months	
				1946	1941		1946	1941
Ford	4,579	10,523	17,325	54,298	102,394	−47.0	23.51	28.93
Chevrolet	15,818	17,217	21,722	48,432	119,183	−61.1	20.13	33.67
Dodge	8,796	10,171	5,951	45,275	31,992	+41.8	19.59	9.04
International	6,249	6,003	8,580	30,781	49,673	−38.0	13.32	14.03
Willys-Jeep	3,742	2,994	214	15,056	984	+1427.0	6.52	.28
Studebaker	2,447	2,142	456	7,722	2,210	+250.0	3.34	.62
G. M. C.	1,093	2,235	3,800	5,742	22,747	−74.7	2.48	6.42
White	761	1,066	835	4,584	4,686	− 2.0	1.98	1.32
Mack	287	460	851	3,691	4,686	−21.1	1.60	1.32
Reo	545	715	135	3,658	753	+386.0	1.58	.21
Diamond T	167	473	507	2,811	3,235	−13.0	1.22	.91
Federal	372	466	114	2,043	775	+163.5	.88	.22
Autocar	373	337	237	1,997	1,258	+58.9	.86	.36
Divco	257	437	228	1,759	1,174	+49.7	.76	.33
Brockway	255	341	179	1,758	1,110	+58.3	.76	.31
Hudson	345	304	86	1,201	477	+152.0	.52	.13
Sterling	41	43	32	276	225	+22.6	.12	.06
F. W. D.	43	62	12	272	121	+125.0	.12	.03
Plymouth	5	1	904	10	5,847	.....	.....	1.60
All others	315	300	97	1,652	715	+131.0	.71	.21
Total	46,438	56,285	62,265	231,068	354,045	−34.7	100.00	100.00

* From R. L. Polk & Co.

News of the Industry

(*Contniued from page* 54)

prices. Not all companies, of course, will change models early in the year. Kaiser-Frazer and Studebaker are now producing what they term 1947 cars and would not appear to require a changeover in the first part of next year, at least. Packard announced a few weeks ago that new models would be delayed well into next year. With the present confusion on model changeover time pretty well scattered, it may take a year or two for the industry to struggle back to the prewar pattern when all companies made the changeover in Summer and early Fall months.

Building Restrictions Hit Automotive Industry

The heavy hand of government restriction on non-residential housing has delayed for at least a year many projects which the automotive industry had planned to start this year. It is not thought likely that either the Ford or the General Motors research centers have a chance to get under way for a year. Some companies have been able to complete projects which were started before the present restrictions were imposed, but getting approval for further construction is becoming more difficult all the time. General Motors, however, did succeed in getting the green light on construction for the new Chevrolet-Cleveland Division of a plant for manufacture of the lightweight Chevrolet which is slated to appear late next year. The high cost of construction also is reported to have prompted some automotive manufacturers to pigeon-hole some of their less urgent building plans until costs come down again.

Nash Workers Strike For New Automobiles

An indication of what organized labor will do to enforce its demands on management is seen in the strike at the Nash body plant. Workers there refused to work on bodies slated for export in an effort to force the company to set aside more cars for factory employes. Nash has been allocating 26 cars a week to its workers, but that number was not enough to satisfy the union. The company has been exporting only about 6 per cent of its production, but the union chose to refuse to work on bodies for foreign shipment in an effort to force a larger quota for the employes. The issue was negotiated in due time, but only after loss of several days production.

CALENDAR

Conventions and Meetings

Instrument Society of America, 1st Natl. Show, Pittsburgh	Sept. 16-20
Automotive Electric Assoc. Fall Meeting, Asheville, N. C.	Sept. 22-25
SAE Natl. Aeronautic Mtg. & Aircraft Eng. Display, Los Angeles	Oct. 3-5
Amer. Management Assoc. Industrial Relations Conf., Boston	Oct. 8-9
Amer. Society Tool Engineers, Semi-Annual Convention, Pittsburgh	Oct. 10-12
1946 Natl. Aviation Clinic, Oklahoma City	Oct. 14-17
SAE Natl. Transportation and Maintenance Meeting, Chicago	Oct. 16-17
Amer. Soc. Body Eng. Technical Meeting, Detroit	Oct. 23-25
Natl. Tool & Div. Mfgrs. Assoc. Convention, Chicago	Oct. 23-26
SAE Natl. Fuels & Lubricants Mtg., Tulsa	Nov. 7-8
French Aero Show, Grand Palais, Paris	Nov. 15-Dec. 1
Natl. Aircraft Show, Cleveland	Nov. 15-24
American Welding Society Annual Meeting, Atlantic City	Nov. 17-22
Natl. Metal Congress and Exposition Atlantic City	Nov. 18-22
American Assoc. Motor Vehicles Adm., Annual Mtg., San Francisco	Nov. 18-21
SAE Natl. Air Transport Engineering Mtg., Chicago	Dec. 2-4
Natl. Standard Parts Assoc. Conv., Atlantic City	Dec. 6-7
Motor & Equip. Wholesalers Assoc. Convention, Atlantic City	Dec. 6
Automotive Service Industries Show, Atlantic City	Dec. 9-14
Society for Experimental Stress Analysis, Annual Mtg., New York	Dec. 9-11
Int. Aviation Celebration & Exhibition, El Paso	Dec. 12-15
SAE Annual Mtg. & Eng. Display, Detroit	Jan. 6-10

Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE *and* AVIATION INDUSTRIES

Continuing approximate stability of business activity, at levels near the July peak, is indicated. *The New York Times* index for the week ended Aug. 24 stands at 136.4, as against 136.9 for the preceding week and 127.5 a year ago.

Sales of department stores during the week ended Aug. 24, as reported by the Federal Reserve Board, equaled 254 per cent of the 1935-39 average, as compared with 239 per cent in the week before. Sales were 40 per cent above the corresponding distribution a year earlier, as against a preceding similar excess of 92 per cent. The total in 1946 so far reported is 30 per cent greater than the comparable sum in 1945.

Electric power production was further increased in the week ended Aug. 24. The output was 8.0 per cent above the corresponding amount in 1945, as compared with a like advance of 12.3 per cent shown for the preceding week.

Railway freight loadings during the same period totaled 884,957 cars, 0.3 per cent less than the figure for the week before but 3.7 per cent above the corresponding number last year.

Crude oil production in the week ended Aug. 24 averaged 4,836,150 barrels daily, 6600 barrels less than the preceding average and 55,400 barrels below the comparable output in 1945.

Production of bituminous coal and lignite during the week ended Aug. 17 is estimated at 11,990,000 net tons, 2.9 per cent below the output in the week before. The total production in 1946 so far reported is 14.5 per cent less than the corresponding quantity in 1945.

Civil engineering construction volume reported for the week ended Aug. 29, according to *Engineering News-Record*, is $79,905,000—18 per cent less than the preceding weekly figure but 126 per cent above the comparable sum in 1945. The total recorded for thirty-five weeks of this year is 194 per cent more than the corresponding amount in 1945. The increase in private construction is 472 per cent, and the rise in public construction is 68 per cent.

The wholesale price index of the Bureau of Labor Statistics for the week ended Aug. 24 is 128.4 per cent of the 1926 average, as compared with 128.3 for the preceding week and 105.5 a year ago.

Member bank reserve balances declined $66,000,000 during the week ended Aug. 28. Underlying changes thus reflected include a decrease of $7,000,000 in Reserve bank credit and a rise of $80,000,000 in Treasury deposits with Federal Reserve banks, accompanied by an increase of $11,000,000 in money in circulation.

Total loans and investments of reporting member banks increased $120,000,000 during the week ended Aug. 21. A rise of $121,000,000 in commercial, industrial and agricultural loans was recorded. The sum of these business loans, $8,146,000,000, shows a net increase of $2,468,000,000 in twelve months.

Turnover High and Productivity Down in Automotive Plants

Automotive spokesmen report that labor is extremely restive and that turnover is unusually high, especially among veterans. The reason advanced as a partial explanation is that with many interruptions of production caused by short supplies, the work week is curtailed, leading to dissatisfaction with reduced pay checks and a general urge to look elsewhere for greener pastures. Productivity also is a serious problem, and every effort to improve it is met by a "resistance movement" egged on by union stewards. One company found that when it tried to step up production of machined parts, scrap mounted seriously. Another discovered that when it attempted to boost the assembly rate, about half the bodies were not completely finished. Union publications take up the hue and cry with the time-worn howl of "speed-up." The general attitude of labor in the plants is not good. The men are restless, discontented, and uneasy. Their living costs are rising, their work is not too steady, and they appear to have caught the generally unsettled fever pervading the whole country. No one seems to know just how to handle the problem, and there does not appear to be any solution in sight.

Air Briefs (Continued from page 27)

find a wide market in messenger service, patrol work and "motorcycle-type" uses.

Telemeter Tests

The Navy recently displayed a system of aircraft testing by remote control which promises elimination of test pilots and a great saving in time required for accurate evaluation of aircraft loads on experimental types. The system makes use of resistance-type strain gages attached throughout the structure and feeding into a multi-channeled transmitter which sends the data to ground stations containing automatic recording equipment. Through the use of remote radio control, the pilotless experimental airplane is flown through required maneuvers, including the critical terminal velocity dive, while information on the loads and accelerations on the plane and structural elements are telemetered to the ground. Both a Curtiss Helldiver and a Grumman Tigercat have been equipped and tested by this method and were featured in a recent Navy demonstration.

Constellations Cleared

Following exhaustive hearings by the Civil Aeronautics Administration, the Lockheed Constellation has been absolved of all suspicions of structural failure or malfunctioning of the power plant, hydraulic, air conditioning or ice elimination systems. Cause of the crashes have been revealed as a tiny stud carrying current from the wing through the fuselage. Although an unconventional practice (most aircraft current is carried by cable from the engine generators to the fuselage power panel), the stud was resorted to due to the necessity for air-tightness in the pressurized cabin. Poor insulation of the stud started fires in the cabin wall insulation. Redesign of this feature, together with several other recommendations (including fuel injection equipment) is being completed.

Talent Scouts

So severe has grown the shortage of engineering personnel in the aircraft industry that Boeing Aircraft Co. has initiated a "talent scout" program of interviewing senior classes of engineering schools to acquaint students with the work done by Boeing and the various technical skills required. An early significant result of this program has been the revelation that many deans and professors of engineering schools were unaware of the variety of technical jobs available in the aircraft industry, particularly those other than aeronautical engineers. Boeing is currently seeking 250 engineers by the first of the year and an additional 200 by July 1, 1947. Most observers see little relief for the present shortage of engineers until 1949 when current engineering classes graduate.

Power Package

Installations of engine, accessories, propeller, engine mount, lines and control cables in a single unit ready for bolting to the airplane are now available. First such unit was the Rohr-Wright "power package" comprising a Wright R-1820 Cyclone engine ready for installation in a Douglas DC-4, or similar type. Latest design is offered by the Ranger Division of the Fairchild Engine and Airplane Corp. The "package" was developed for the new Navy Edo XOSE-1 seaplane and includes a Ranger V-770-8 engine with all equipment. Unique is the integration of the oil tank and system within the package. The unit is assembled to the airplane by four bolts. Chief advantages are: ease of maintenance, interchangeability and quick mounting.

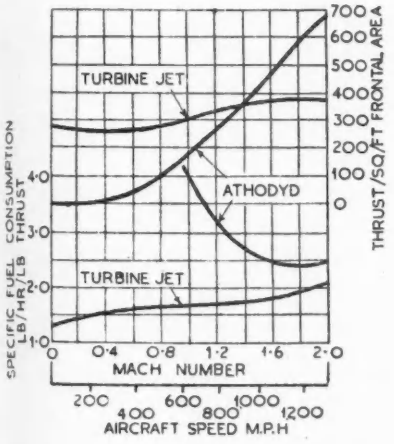
Ram Jet Engine

(*Continued from page* 37)

pressure decreases and velocity increases along a converging duct:

In any nozzle, Mach number 1 is developed at the minimum section. This is a direct consequence of the conservation of mass flow and energy. In the ordinary De Laval nozzle, sonic speed is reached in the throat by speeding up a subsonic flow. The kind of flow obtained in the diffuser section depends on the back pressure at the large end of the diffuser. If this pressure is very low, supersonic flow is obtained and a normal shock will occur at such a position as to match the exhaust pressure. As the back pressure is increased the shock will gradually move upstream toward the throat and finally disappear.

For higher pressure the flow will be entirely subsonic. Now in the reversed De Laval nozzle, we are considering the case where the entry flow is supersonic; therefore, by referring to the previously discussed case, it is seen that the pressure must start low and increase as the velocity decreases to sonic speed at the throat.



This chart from a paper presented recently in England by Dr. S. G. Hooker of Rolls-Royce Ltd. gives a comparison of the high output turbo-jet engine and the athodyd (ram jet engine) at an altitude of 40,000 ft. Above 900 mph the athodyd has an increasing advantage over the turbo-jet engine in unit thrust output, according to Dr. Hooker.

5. Reasons behind: "If the speed of the air past, the duct is sufficiently increased to attach the shock to the nozzle, it will suddenly jump inside to the expanding part of the diffuser." (This in the reversed De Laval arrangement):

Although I have heard rumors that it has been done, it is generally considered impossible to stabilize a normal shock wave in the converging section of a nozzle. This results from the fact that pressure behind the shock wave is always higher than would be obtained by shock free or isentropic compression to the throat. Let us take the ramjet, reversed, De Laval nozzle through a cycle. As the Mach number increases in the supersonic range on the upstream side, Mach number 1 will be maintained at the throat and a normal shock wave starting from a detached position will gradually approach the intake. As the Mach number increases beyond that necessary for shock at the rim, it will jump to the position downstream of the throat section. If the Mach number is now reduced, this shock will gradually move upstream, disappearing at the throat. At the moment of disappearance the flow is isentropic, but any small disturbance causes the condition of detached shock to reappear.

6. Elaboration on the statement,

(*Turn to page* 68, *please*)

"Another method of preventing large loss in entropy due to compression at high supersonic speeds is to use a series of diagonal or conical shock waves":

Diagonal shocks are less intense than normal shocks and the flow may be slowed down with consequent pressure recovery with a small gain in entropy. If the amount of pressure gain at each diagonal shock is made infinitesimal the gain in entropy of a finite series of such shock waves is also infinitesimal. For example, at Mach number 3 pressure recovery after normal shock is 33 per cent of the isentropic value. If one diagonal shock of the right intensity is chosen ahead of the normal shock the pressure recovery is raised to 58 per cent. If there are two diagonal shocks followed by normal shock the recovery reaches 80 per cent at this Mach number.

Hot Dimpling

(*Continued from page* 26)

setting established in step three and pulled in a tensile testing machine. If any of the specimens are appreciably low with a break around the perifery of the dimple, it is a good indication of insufficient heat. If the specimen falls too low, breaking through the center of the dimple, and shows considerable necking around the dimpled area, it is an indication of anneal.

If the type A specimens are considered within range, two type B specimens are made and inspected metallographically for internal shear cracks. The use of the type A specimen has virtually eliminated the necessity for metallographic work because an internal shear crack has never been found when the procedure as previously outlined was used.

Results are plotted on a quality control chart. Type B specimen is used daily for visual control of the dimpling process and type A is used only for original certification and periodic checks of the machine.

Whenever possible, sheets and parts requiring dimpling are brought to the stationary hot dimpling machines. Other parts are dimpled cold with modified 24S-T dimpling tools (see Fig. 7).

Tools for both 75S-T hot and cold dimpling are identified by a circumferential groove on the body of the tool. Tools used for hot dimpling may be differentiated from those used for cold dimpling (sub-dimpling tools) by a tapered die face and a 0.375 in. diam shank. Cold dimpling tools have an 0.250 in. diam shank. Preparation of the material to be dimpled consists of the following steps:

1. Drilling holes in the sheet with same size drill as nominal rivet size in the sheets. 2. If the holes are drilled clean, no further operation is necessary. However, if a heavy burr is developed, light burring of the holes has been found to be beneficial. 3. The material must be free of paint, oil and any other foreign material. If the material is 75S-T it is essential that it be etched to prevent arcing. It is not essential to clean alclad parts that have not been painted or oiled.

More High Speed Grinding Wheels

United States Rubber Co. announced that plans are being made to triple its production of high-speed grinding wheels used by steel mills, foundries and metal fabricating plants.

Increased production facilities will be established in a new plant in Ft. Wayne, Ind., recently acquired from the government.

Steam Car Industry in America

(*Continued from page* 40)

when the triple-laced demountable wheel was introduced here.

There was relatively little Government interference with the use of steam carriages in this country. When these vehicles first appeared on the highways, their manufacturers and owners were advised that the boilers were subject to inspection, the same as all other high-pressure boilers. Gasoline-fired steam carriages were transported on ferry boats, but their fires had to be extinguished before they were pushed onto the boats, and they were segregated at the rear end of the deck. Convincing proof of the lack of explosion hazards was furnished by the manufacturers who had their boilers inspected, and leading insurance companies issued insurance on approved makes. While the ownership and operation of a steam car may have involved a few extra formalities and precautions, these certainly did not preclude the practical success of the vehicle.

For a period of about two years, from early in 1900 when the Locomobile Co. went into production, until the end of 1901, the light steamer held an easy supremacy in the American automobile market. On the assumption that the Stanley design met all practical requirements, the Locomobile, Mobile, and several other companies had built factories and installed equipment for quantity production as it was then understood, which enabled them to offer the light vehicles at attractive prices. The vehicles themselves had many obvious attractive features, and eager purchasers were not lacking. But with their introduction in service their many faults became only too apparent, and as simultaneously light, silent and low-priced gasoline runabouts appeared on the market, the popularity of the steamer began to wane. It was the curve dash Oldsmobile runabout, more than any other car, that took the market away from the steamer, and the writer remembers one of his associates remarking at the time that in East Orange, one of New York City's high-class suburbs, these gasoline runabouts were "as thick as flies." Some of the concerns which had been engaged in the manufacture of steam cars, like the Locomobile Co. of America, took up the manufacture of gasoline vehicles, while others went out of business. At the New York show in January, 1905 only three makes of steam car were on exhibition and these, together with the Stanley, which was not shown, were about all that were left.

With the ascendency of the gasoline automobile the latter became a model for steam-car manufacturers in various respects. Thus from 1904 on, either the boilers or the engines were located under a hood in front, the engines were completely enclosed, and gear drive was used. The dimensions of the vehicles and the outputs of their engines were increased, and bodies similar to those of gasoline cars were fitted. The White Co. even introduced a two-speed gear mounted on the rear axle. On hills the low-speed gear was used, which enabled the engine to keep up its speed and obviated the need for pumping feed water by hand.

Still the market continued to decrease, and soon the Stanley and the White were the only makes left. One of the factors in the gradual disappearance of the steamer was that the average service-station staff knew little or nothing about steam powerplants, and it was very difficult to get service. In the smaller communities, particularly, the steam-car owner was thrown practically on his own resources. Finally, in 1911 the White Co. decided to discontinue the manufacture of steamers and to confine itself to the production of gasoline cars, upon which it had entered some years earlier. The Stan-

(*Turn to page* 74, *please*)

"IN-BETWEEN STEP"

that leads to better

MACHINABILITY

It's furnace treatment—an important step between hot rolling and cold drawing of steel bars, or between the cold drawing operation and the use of the bars in automatic screw machines or other machine tools. It may be annealing, normalizing, spheroidizing, stress relieving or other form of furnace treatment.

Furnace treatment of the cold drawn steel bars you use can bring you several distinct advantages:

1. It insures uniformity of structure, physical properties, hardness and surface.
2. It permits consistent production of the particular microstructure best suited to the machining operations involved.
3. It relieves internal stresses which, especially in the higher carbon type bars, can result in warpage and distortion during unsymmetrical machining.
4. It substantially increases the most important quality of cold drawn steels—MACHINABILITY.
5. If you manufacture steel parts which are surface or selective hardened by induction heating methods, the bars can be furnace treated in prepared atmosphere to prevent decarburization.

Always alert for ways to improve cold drawn steels and to step up MACHINABILITY, Republic's Union Drawn Steel Division has installed the most modern furnace equipment in its various plants to supply *every type* of furnace treated cold drawn steels, both in coils and in bar form.

And Republic metallurgists are ready to discuss the benefits of these steels as applied to *your specific product.* Write us.

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Union Cold Drawn Special Sections

•

Union Cold Drawn and Ground Rounds; Turned and Polished Rounds; and Turned, Ground and Polished Rounds (Union Precision Sizing.)

ley company continued operations until 1923, when it was placed in the hands of a receiver. The brothers had withdrawn from active connection with the firm when a reorganization took place, in 1917, and one of them was killed in an accident during the early twenties.

It must not be assumed that the final disappearance of the steamer was due in any way to the many defects of the early designs, on which considerable stress has been placed in this article, for most of these defects had long been eliminated. The postwar Stanley car, of which a photograph is shown in Fig. 21, had a wheelbase of 130 in., considerably more than twice as long as that of the prototype, and in appearance differed little from the gasoline cars of the period. It had no water glass, the water level being read off an indicator dial on the dash. There was no need for pumping up air pressure by hand, as fuel feed was by a power pump. A condenser was fitted and one water supply was good for between 100 and 200 miles. The water supply, moreover, could be replenished by means of a steam siphon. A thermostatic valve automatically shut off the fuel supply to the boiler when the water level therein dropped dangerously low. Kerosene was used as fuel, except in the pilot light, which latter was ignited by a so-called sparking gas lighter. The steam was superheated, and the engine was enclosed and drove directly to the rear axle by spur gears.

The falling off in the demand for steam cars therefore was not due in any way to lack of engineering development; on the contrary, the last steam car models were "over-engineered," if anything. These cars sold at prices ranging from $2750 for the runabout to just below $4000 for a seven passenger limousine. Well built gasoline cars of the same size could be bought for about one-half that price, so that the steam enthusiast had to "dig deep" if he wanted to remain true to his convictions.

In closing it may be apropos to say a few words regarding attempts to stage a comeback of the steam car. The first of these was made in 1916, by Abner Doble, who designed and built a steam car on the lines of the then current gasoline-car models. The Doble car figured prominently in the public prints of the period, and at one time no less than three Doble steam-car companies were listed in industrial directories, domiciled, respectively, in Maine, Michigan, and California. But the writer was informed that no more than ten Doble cars were built in the United States, and if this be true, a much greater tonnage of paper must have been consumed in Doble publicity than the steel tonnage that went into Doble cars. One alibi for the failure of Doble's Detroit venture was that wartime restrictions (World War I) made it impossible to get materials. However, these restrictions were in force for a relatively short time, and if the undertaking had otherwise been sound, it would undoubtedly have survived them.

During the third decade of the century, when the production of giant pneumatic tires made possible rapid development of motor-bus services, some promoters saw the solution of the bus problem in steam power. One of the factors that had contributed to the failure of the private steam passenger car, the lack of service facilities, did not have to be counted with in public-service undertakings, as these could organize and train their own service staffs. At least four or five companies did development work on steam buses, but not one of them reached the production stage.

Bobbi Motor Car Corp. Moves to Birmingham

Bobbi Motor Car Corp. has shipped its equipment in a move from San Diego, Calif., to Birmingham, Ala. The firm had planned to produce small sized Bobbi-Kars in Consolidated Vultee Aircraft Plant No. 2, but decided to move to the new location when the State Corporation Commission showed reluctance to issue a permit to sell stock. Although the Securities Exchange Commission had approved the sale, the Calif. State Commission had not.

Aircraft Industry Makes Good Progress in 1946

(*Continued from page* 19)

materials, parts and equipment into the industry. Severe shortages have developed in aluminum sheet (Alcoa 75S in particular), certain steel items, electrical switches, assemblies and equipment, aircraft fabric and purchased commercial parts. Sub-contractors have been forced to halt their deliveries altogether, in certain extreme instances, and deliveries slowed to a trickle in many others. For example, one manufacturer has been completing airplanes and parking them on the field awaiting deliveries of certain flight instruments, which are installed upon receipt. Most serious shortage in the lightplane field is aircraft fabric, created by unprecedented demands by the garment industry and withholding by numerous manufacturers in the face of OPA pricing policies. As these individual situations are cleared, the industry will accelerate production accordingly.

Loss of Skills

Reduced quantities, cooling of patrictic ardor, less elaborate tooling, reduction in processes and separation of large segments of skilled personnel have combined to create drastic increases in production costs in the industry. As an index of this rise, the present estimated production cost of aircraft of $25 to $30 per airframe pound is to be compared to approximately $5 per pound existing during the war. A major culprit in this increased cost is reduced individual productivity, which has dropped from 96 lb of airframe per employe per month tc about 10 lb.

The elaborate tooling, which facilitated the astounding production during the war, has practically disappeared with the result that each employe now accomplishes more individual and diversified operations on the aircraft than formerly, when a typical worker did only one routine job throughout the day. This has reduced the number of individual operations on a given airplane by as much as 75 per cent in some cases.

Still another important contributing factor to increased production costs is increased wages as well as materials costs. Gains made by organized labor

(*Turn to page* 78, *please*)

Shipments of Complete Aircraft in United States for First Six Months of 1946

MILITARY AIRCRAFT

Type of Aircraft	No. of Planes
Total	606
Bombers and heavy transports	116
Fighters	490
Helicopters	X
Gliders, targets and pilotless aircraft	X

CIVIL AIRCRAFT

Product	No. of Planes
Airplanes:	
Total	13,311
Classification by number of places:	
Fixed-wing planes:	
2-place	12,657
3-place and over	649
Helicopters, 2- and 4-place	...
Classification by number of engines:	
1 engine	13,005
2 and 4 engines	306
Classification by total rated horsepower (all engines):	
1-74 hp	9,380
75-99 hp and 100-399 hp	3,624
400 hp and over	307
Gliders	X
Conversions	67

X—Data not shown to avoid disclosing the operations of individual companies.
Source: Bureau of Census.

(*Continued from page* 76)

in wages has been at the expense of production costs which are far more difficult to recapture in increased sales prices in aircraft than in most other industries. Firm contracts, both with the airlines and with the Government, permit few opportunities for increased return and, in most cases, no increases are possible. Thus, the industry is bracketed between this "floor-and-ceiling" as severely as in other industries and, in many cases, far more so.

Selective Service

A major shift in accent from production to research and development has emerged within the industry in the past year. Whereas as little as five per cent of total employment comprised engineering and research departments during the war, the total has risen to as high as 50 per cent in some companies with about 30 per cent the predominant average. This has been created by increased research and development work on military contracts, the creation of new models and the planning of future types.

Because the great bulk of these engineers are comparatively youthful, however, the increase in engineering personnel has been seriously hampered by the draft. A survey has revealed that approximately 20 per cent of the current engineering staff of the industry is subject to the calls of Selective Service and individual companies reveal that as high as 40 per cent of their present staff is subject.

Although amendments to the Selective Service act to exempt aircraft engineering and research workers were proposed during the recent debates over its extension, it was pointed out that Local Boards already have the power to exempt such workers and therefore no formal amendment to the Act was necessary. However, Local Boards, pressed for quotas, are dipping into this reservoir liberally and creating serious problems to the progress of this highly strategic phase of the aircraft industry.

Guided Missiles

It is safe to say that research and development work in the radically new guided-missile field comprises the largest single segment of effort by both the War and Navy Departments and shows every promise of converting the aircraft industry into a "guided missile" industry in the foreseeable future. The Army Air Forces, Army Ground Forces, Army Ordnance Department, Navy Bureau of Aeronautics, Navy Bureau of Ordnance and Navy Bureau of Ships each have extensive guided-missile research programs well under way with certain minor phases already graduated to the production stage.

Early fears that this unorthodox type of weapon would become the property of the electronic, chemical, automotive and mechanical industries and

(*Turn to page* 82, *please*)

(*Continued from page* 78)

would be divorced from the parent industry have now been proved unfounded and the aircraft industry is not only shouldering a major part of the present burden but must expand its facilities and technical manpower as rapidly as possible to absorb the increasing workloads of these programs.

It is particularly significant that, whereas each of the universities, industrial laboratories and non-aircraft firms engaged in guided-missile work have contracted only for one or two highly specialized phases of the project, aircraft industry contractors are charged with the simultaneous development of aerodynamics and design, propulsion, guidance and control, warheads and launching equipment of each model. Another significant fact is that guided missiles, even in the experimental stage, are expendable and the first firing is the last. This means that whereas only one giant bomber may be built for test purposes, an experimental guided-missile contract may call for 50, 100 or 1000 articles.

The extent of aircraft industry participation in the guided-missile program may be gaged by the following list of companies which hold one or more guided-missile contracts: The Glenn L. Martin Co., North American Aviation, Inc., Curtiss-Wright Corp., Republic Aircraft Corp., Consolidated-Vultee Aircraft Corp., Northrop Aircraft, Inc., Hughes Aircraft Corp., Bell Aircraft Corp., Douglas Aircraft Co., Inc., Fairchild Engine and Aircraft Corp., Goodyear Aircraft Corp., Continental Motors Corp., Lockheed Aircraft Corp., Boeing Aircraft Corp., McDonnell Aircraft Corp., Bendix Aviation Corp., Ryan Aeronautical Corp. and Kellogg Aircraft Co.

The vast majority of these projects, however, are in the research and design stage, with heavy accent on engineering and scientific talent, and the effects of the program will not be felt in the production departments for possibly another year. For this reason, too, the dollar volume of these contracts do not bulk large in backlog figures although they are firm indices of vastly increased future production business.

Future Prospects

From the foregoing it is clear that the future prospects of the aircraft manufacturing industry are exceedingly bright and far, far more promising than at this time one year ago. Although the personal aircraft industry shows every prospect of producing a total of 50,000 lightplanes during 1947, and nearly 1000 multi-engine transport aircraft are scheduled, the dollar-volume of manufacturing hinges heavily on the military procurement programs, which has constituted from 60 to 75 per cent of the industry's business during its peace years.

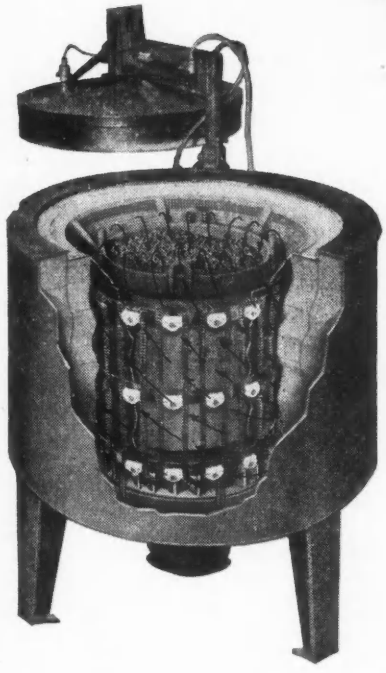
The military programs for fiscal year of 1947 are as follows: Army Air Forces will spend $369,000,000 for the purchase of 1020 military aircraft; Bureau of Aeronautics will spend $310,000,000 for the purchase of 1087 naval aircraft; a total of 2107 aircraft. Although this is up, slightly, from the 1946 program, it does not reveal the true extent of military business with the industry. Figures for research and development work, particularly in the field of guided missiles, are restricted information but an index is provided by the total research appropriations of these departments: $185,000,000 for the Army Air Forces and $100,626,000, a majority of which will be channeled into the aircraft industry.

Auto-Lite Purchases Plant at Owosso, Mich.

Continuing the expansion of manufacturing facilities, the Electric Auto-Lite Co. has purchased a new plant at Owosso, Mich. The plant, of steel and brick construction and covering 144,000 sq ft, will be operated by the Auto-Lite Battery Corp. for storage batteries.

The Owosso plant will be the seventh in the Auto-Lite network exclusively devoted to the manufacture of batteries. Plants are now being operated in Niagara Falls, N. Y.; Atlanta, Ga.; Indianapolis, Ind.; Oklahoma City, Okla; Oakland, Calif. and Toronto, Ontario, Canada.

Croname, Inc., Chicago, heat-treats in these 5 Homo Furnaces. Note evenness of soak temperatures in varied records at right.



Break-away view shows how features which Homo pioneered 20 years ago enable modern Homo to heat-treat with extreme uniformity. Air stream from fan directly beneath the work holds its swirl as it hits work—doesn't channel—penetrates any load evenly. Homo saves space—needs only enough area for the compact furnace itself.

Homo Method Gives Speed For Today's Tempering

Today's need for accurate, fast tempering is met in two ways by the Homo Method:

1. Fast heating-up of loads. Homo Tempering meets this speed need by heating with fast-moving, clean, electrically-heated air. Forced through the load by a powerful fan located only inches below the work, this air travels the short, efficient path necessary for fast, accurate heating.

2. Fast change of soak temperature—so that successive batches can be run at different temperatures without undue waiting for the furnace. The Homo Method meets this need because the furnace is close-coupled and compact. It needs only minimum refractory and therefore stores minimum heat. The Homo Method concentrates all the heat possible in the work itself for fast, uniform, reject-free heat treatment.

If you have a specific tempering problem, an L&N engineer will be glad either to call or to send Catalog T-625, as you prefer.

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Jrl Ad T-625(33a)

Two Innovations

(*Continued from page* 41)

Although the equipment has been in use for a relatively short time, the management finds that cutter life is excellent, the current performance being about 1500 pieces per grind.

Fig. 1 is a view of the Revacycle machine for producing 16-tooth side gears. In addition to the automatic cycling of the cutter and gear index, the machine also is equipped with an overhead magazine feed for gear blanks as well as automatic ejection of the finished gear. At the instant the machine stops, the hopper at the center of the machine is moved into position directly under the work spindle and receives the gear as it is automatically ejected from the spindle. At the same time a gear blank is pushed into place onto the spindle ready for the next cycle. The magazine chute is so designed as to receive the gear blank in only one position, which not only provides a factor of safety but also relieves the worker of the burden of accurately loading individual pieces.

The outer end of the hopper, in turn, communicates with an indexing holder or container and drops the finished gear onto one of the spindles. The container for the differential side gear machine has 8 spindles and each spindle holds six pieces. Thus each container carries 48 gears. The container for the smaller pinions has 10 spindles and each spindle holds nine pieces, thus carrying 90 pieces for a full load. As a container is filled, the operator removes it and replaces it with another.

Even in its present form the operation may be considered as experimental and subject to detail improvement leading to further economy. For example, at the present time it is necessary to introduce an extra operation for burring and chamfering the gear teeth after they leave the machine. This is done by the operator handling the group of machines. Gleason already is engaged in the development of an attachment for the circular cutter which will burr and chamfer the gear tooth as part of a station of the cutter within the same time cycle and without increasing cutting time. When this attachment is made available it will eliminate the extra operation as well as the chamfering machines.

The foregoing is cited as an excellent example of the latent possibilities for cost reduction by the adoption of postwar machinery of advanced design. Considering the machine tool itself; it is interesting to find that the overall equipment cost is less than with former practice. The new machine costs about the same as its predecessor but productivity is more than doubled. Consequently, the machine-hour rate is considerably smaller and amply justifies the new investment.

Coming to the other phase of management activity consider that the manufacture of heavy duty trucks involves the handling of large and heavy parts. Apart from a consideration of cost and productivity there is an imperative need for mechanical handling devices designed to relieve workers of the physical burden so far as possible, also simple devices to assure the safety of workers dealing with heavy parts.

An interesting solution has been found for the mechanical handling of wheel and tire assemblies and tire inflation with greater speed, complete safety, and considerably less manual effort. Fig. 2 is a view of the new tire press with a feeder conveyor line at the right and the inflation chute at the left. The first step in making the wheel and tire assembly is the assembly of the rim, side ring, and tire and tube. Considering that IHC uses 20-in. wheels and tires ranging from 7.50 to 12.00 cross section, the physical effort required to mount the tire is enormous unless the operator is relieved by mechanical aids.

The management is particularly proud of the solution expressed by the

(*Turn to page* 86, *please*)

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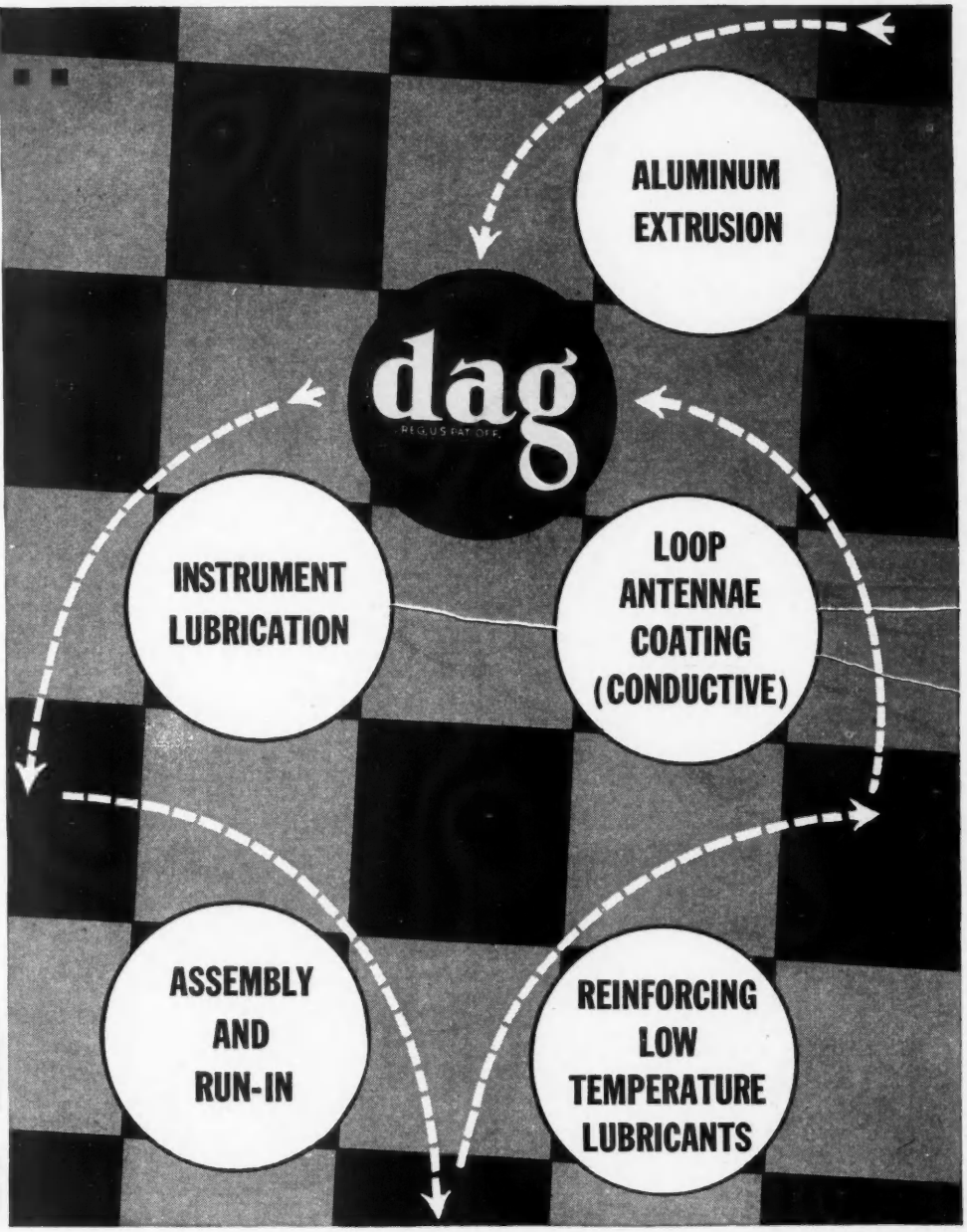

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current set-up. The extreme end of the conveyor leading to the tire press is located directly at the tire and wheel scheduling station so that the operator can easily select the options for each assembly. The end of the conveyor has an air-operated tilting and elevating fixture which, in its initial position, is tilted to permit the worker to mount the wheel, install the rim, then mount the tire and fit the valve, and finally to close the loose assembly by installing the side ring. Then the operator presses a button to elevate the fixture so it lines up level with the conveyor, thus enabling him to shove the assembly onto the gravity roller section and then push the work toward the press.

The press is operated hydraulically throughout its cycle. The work is first dropped onto the table which is then lifted into position. Overhead are a series of plungers, each one operated by an individual heavy duty hydraulic cylinder. When the operator presses the start button, the plungers move down one at a time in a timed sequence, applying a steady pressure until the side ring is securely in place.

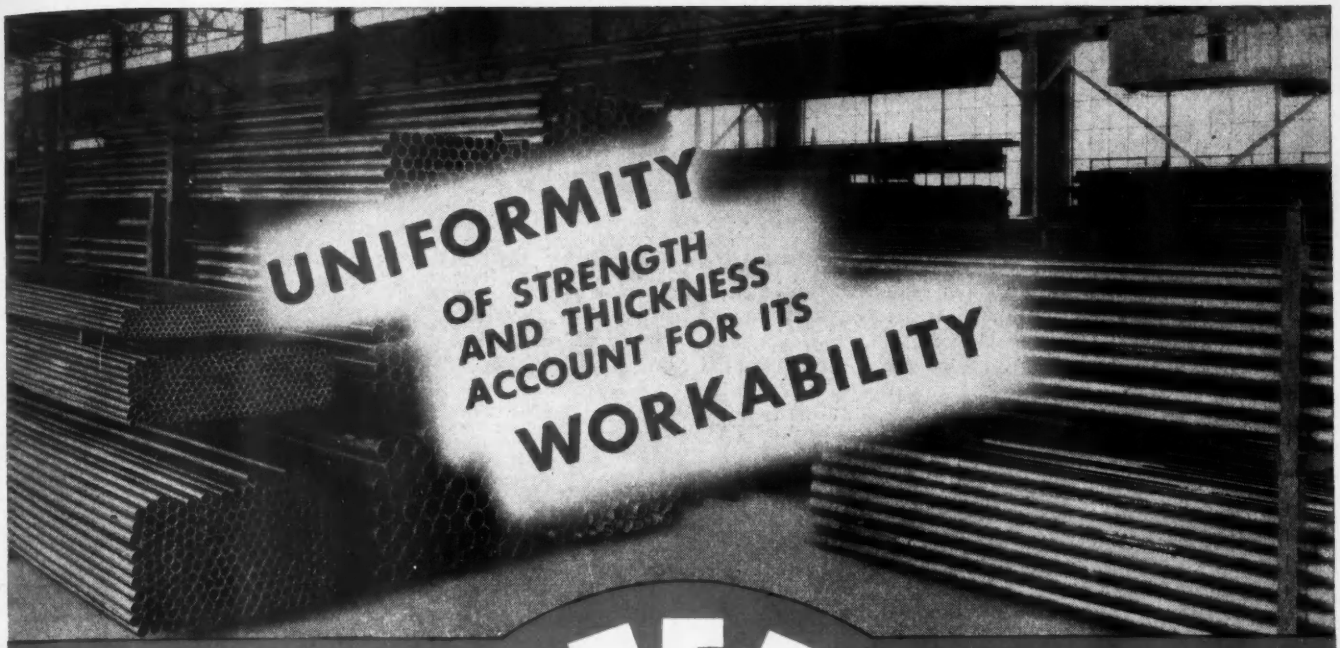
At this point the pressure is relieved, the plungers retracted, and the work is slid out of the press onto a conveyor section at the left. This, in turn, has a short-lift elevating section containing large rollers and when elevated it permits the worker to slide the heavy assembly easily into the inflation chute.

The inflation of heavy tires has posed a serious safety problem for many years owing to the possibility that a side ring may come off under heavy air pressure. To meet this problem, the new chute is heavily framed and latticed so that in event of a side ring accident the worker is adequately protected. Obviously, this arrangement makes it a little more awkward to inflate tires since the operator must insert the valve end of the pressure hose through one of the lattice openings in the frame. But it pays off in increased safety and peace of mind.

Under normal operating schedules IHC has two lines as described above. The conveyor has been so arranged that if one of the presses is down temporarily for repair or adjustment, it is a simple matter to bridge across from one line to the other and have one press handle the work from both assembly conveyors.

650 Civil Aircraft Registered in Britain

At the beginning of the war in 1939 Great Britain had 1783 registered civil aircraft, averaging 2200 lb. The number registered at the end of 1945 was 248 and at the end of June, 1946, the total had increased to 650 civil aircraft, which averaged 16,900 lb. Britain exported 229 small aircraft during the first six months of 1946.



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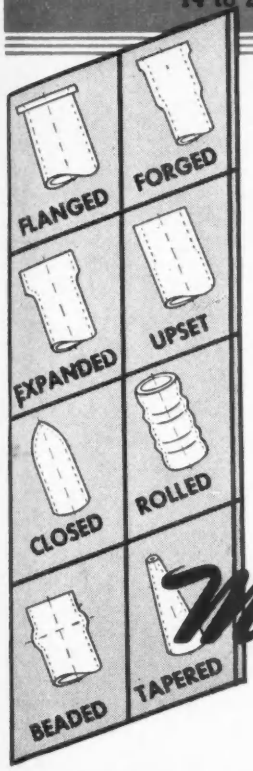
ALSO
SQUARE • RECTANGULAR
Minimum dimension ½"
Maximum dimension 2¼"
14 to 20 gauge.

ROUND
¼" to 4" O.D.
9 to 22 gauge



The "Production Parts Tubing"

Because it re-forms and machines so well, Michigan welded steel tubing is widely used in the fabrication of production parts such as automobile exhaust and muffler tail pipes, gas tank filler tubes, steering jackets, and wherever bent and shaped tubes may be required. True concentricity, uniform I. D. and O. D. make it particularly economical when long runs are involved.

Prefabricated Parts or Tubing

Michigan will furnish the complete part fabricated from welded steel tubing, all re-formed and machined. If you have the equipment and capacity in your own plant to do this work, consider Michigan as your source for tubing in the sizes listed above—commercial mill lengths or cut to special lengths.

Engineering advice and technical help in the selection of tubing best suited to your needs.

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Productivity—Source of Wealth

(*Continued from page* 15)

In the long run this must be so for it is the only way that the mass output of our factories can be absorbed. Labor receives by far the largest share of the fruits of industry. In 1944, for instance, the amount paid out by American industry in the form of employe compensation was more than 25 times as much as was received in the form of dividends to stockholders. Furthermore, the average net return on capital investment for all manufacturing enterprise in this country for the past two decades has been only about three per cent, and this is small compensation for the hazards assumed. It is obvious from these data that the workers have the most at stake in the maintenance of a healthy economy, and that it is sheer folly for them through destructive tactics "to kill the goose that lays the golden eggs."

It should be apparent that jobs do not spring into being by mere pronouncement, Government decree, wishful thinking, or the pressing of a button. Under a free society it is the consumer who by his preferences in the market place determines the type and amount of goods to be produced. Our task, consequently, is to maintain a high level of marketable industrial production. From this stems productive jobs, profits to industry, and revenue to the Government. To accomplish this objective, our economy must be kept within reasonable balance in order that the various groups may be able to exchange goods and services with one another. The closer we come to this realization, the better assurance we have of providing steady jobs and of maintaining high living standards.

Increased productivity is an area of common interests around which all groups can rally in effective cooperation and support policies that will provide more goods and more jobs. It is toward this common objective that the national leaders should focus their attention for its achievement would not only promote industrial progress but would aid in dissolving much of the industrial warfare that has threatened to disrupt our economic system.

The Wimille Car

(*Continued from page* 33)

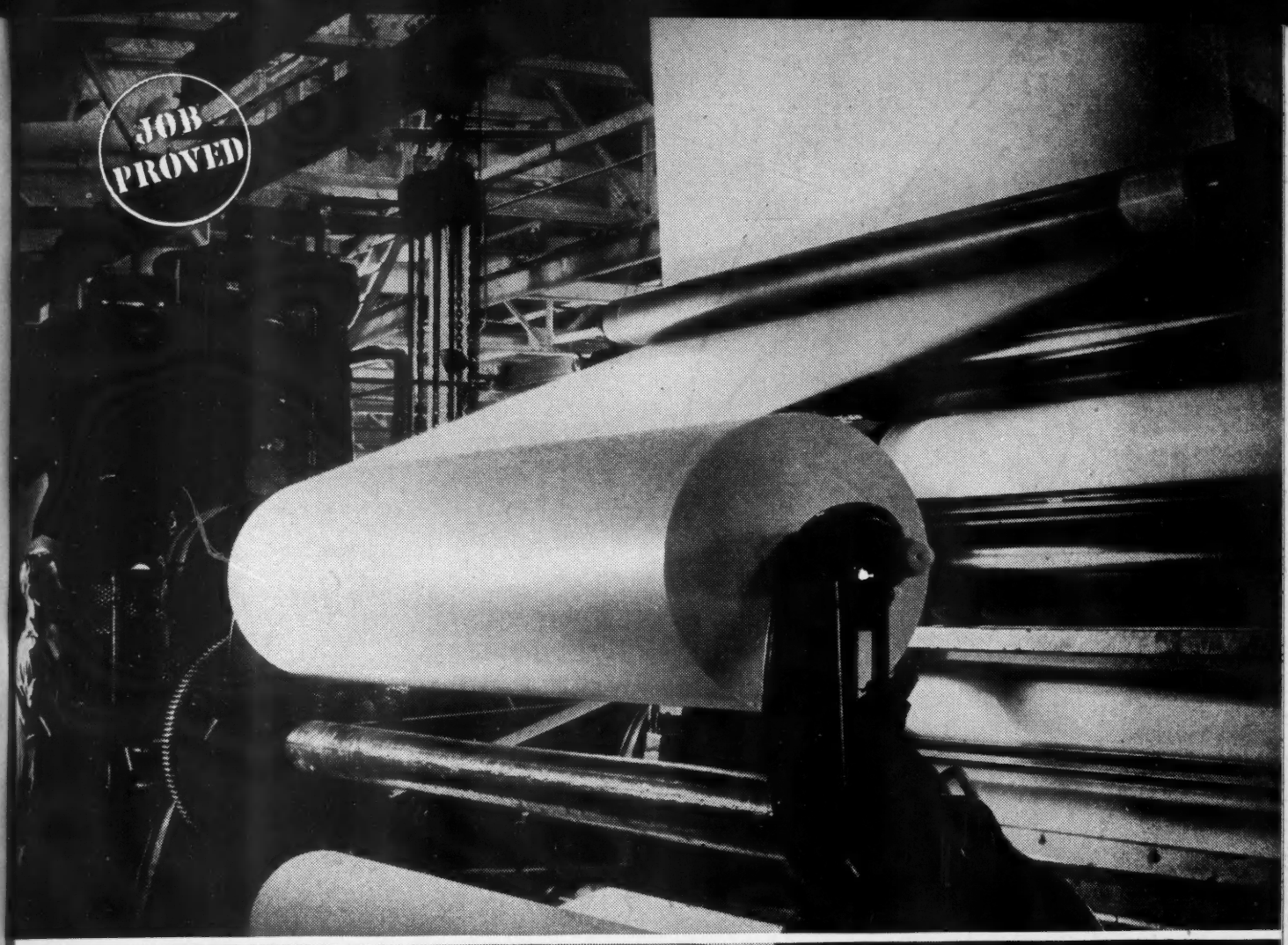
use of a conical joint, the protection of the gasket from direct contact with the explosive charge, and a directed water supply completely round the valve seats and the plugs.

The order of the mounting from front to back is engine, clutch, transmission, with the power takeoff carried forward under the engine and final drive to the wheels by transverse shafts with Spicer joints. There is a very slight overhang of the engine. The transmission is a Cotal electro-magnetic, with four speeds ahead and reverse. Engine mounting is by three points on rubber blocks, the forward point being on a bracket welded to the chassis tubes and the two rear ones direct on the tubes.

Torsion bar suspension is used front and rear. The radius arms are welded steel stampings. The torsion bars are transversal at the rear and longitudinal at the front. Brake drums are in light alloy, with iron liners, and the wheels are also of light alloy. There are three air inlets at the front of the car, the center one being for the radiator and the two lateral ones direct a current of air onto the brake drums.

No difficulty has been experienced in getting adequate engine cooling without scoops or louvers. The air for the radiator is admitted directly to that unit and discharged immediately. The carburetor air intake is on the top of the hood. Air is admitted into the engine chamber at a high pressure zone and evacuated at a low pressure zone, these zones having been determined by wind tunnel experiments.

The car has a wheelbase of 96 in. and a tread of 48 in., front and rear.



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Through eight, long, hard years, the 60 bearings of a big paper-machine in a widely known mill have been running smoothly.

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The mill superintendent says he would not use any other lubricant at any price. Sun Engineers, like the one who recommended the lubricant for this machine, are ready to serve you. They combine broad experience in petroleum technology with the specific requirements of machines.

"Job-Proved" Sun lubricants are on the job through industry, in coal mines, quarries, textile mills, paper mills, rubber plants, machine shops, power houses. To make things go smoothly, to increase production and decrease costs, call the Sun office near you. Or write . . .

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SUN

SUNOCO

INDUSTRIAL PRODUCTS

PICAO Airworthiness Standards

(*Continued from page* 23)

ing filling or during operation. The ability of the cooling system to maintain the outlet temperature at or below the maximum, and above the minimum, established values shall be demonstrated in accordance with the afore-stated means for complying with the requirements of cooling system tests. Means shall be provided to prevent excessive pressures in the cooling system.

COOLANT EXPANSION TANKS, CONSTRUCTION—Coolant expansion tanks shall have a usable capacity of not less than one gal, and shall have sufficient strength to withstand without failure all vibration, inertia, and fluid loads, to which they may be subjected in normal conditions of operation. Coolant tanks shall be provided with an expansion space of not less than 10 per cent of the total coolant system capacity and it shall not be possible inadvertently to fill this expansion space when the airplane is in the normal ground attitude.

COOLANT EXPANSION TANKS, STRENGTH—Coolant expansion tanks shall be subjected to all the tests prescribed for fuel tanks, except as follows: (a) the pressure test prescribed shall be carried out, except that the 3.0 psi pressure shall be replaced either by the sum of the pressure developed during the maximum ultimate acceleration with a full tank plus the maximum working pressure of the system, or by 1.25 times the maximum working pressure of the system, whichever is the greater; (b) in the case of tanks with non-metal liners, the test fluid shall be coolant at maximum operating temperature.

Carburetor-Pre-Heater Tests

Compliance with the following requirements shall be demonstrated when the airplane is operating in air at a temperature of 30 F and free from visible moisture.

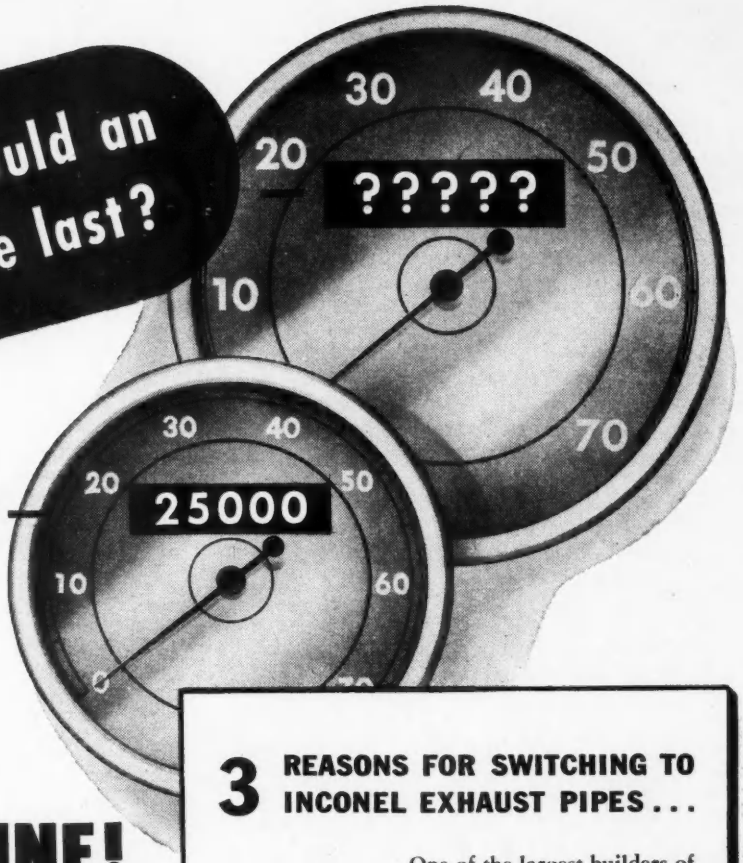
(a) Airplanes with unsupercharged engines employing conventional venturi carburetors shall be equipped with preheaters capable of providing a temperature rise of 90 F, when the engines are operating at 75 per cent maximum continuous power.

(b) Airplanes with altitude-rated engines employing conventional venturi carburetors located ahead of the supercharger shall be equipped with preheaters capable of providing a temperature rise of 120 F, when the engines are operating at 60 per cent maximum continuous power.

(c) Airplanes with altitude-rated engines employing carburetors located ahead of the supercharger, and which embody features tending to reduce the possibility of ice formation, shall be equipped with preheaters capable of

(*Turn to page* 92, *please*)

How long should an exhaust pipe last?



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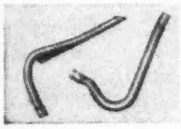

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Inconel has *all* the properties you need in this high-temperature trouble spot.

Containing 80 per cent Nickel and 14 per cent Chromium, this INCO Nickel Alloy stands temperatures up to 2100°F . . . resists the corrosive attack of the exhaust gases . . . never rusts.

Whether you're *building* or *operating* vehicles, it will pay you to investigate this means of ending a frequent and troublesome repair job.

Call or write today for the information you want. Then you can determine how Inconel's long life makes it the *lowest-cost material you could use.*

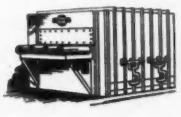
THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall St., New York 5, N.Y.

3 REASONS FOR SWITCHING TO INCONEL EXHAUST PIPES . . .

One of the largest builders of trucks and buses recently ran tests on more than fifteen alloys for exhaust pipes. We asked him to include Inconel. At the end of the tests, this was his enthusiastic report:

"According to our tests, we believe Inconel to be good for the life of the vehicle."

Inconel has already solved the aircraft exhaust manifold problem. Inconel is the "standard" metal for the exhaust manifolds aboard the Pan-American Clippers. Operating from 1500°F. up to white heat, these thin-gauge manifolds (easily fabricated out of Inconel tubing and sheet) withstand the corrosive blast of high-octane exhaust, incessant vibration, rapid heating and sudden chilling. All in all, far tougher service than encountered in bus or truck operation.



Inconel has shown outstanding stamina in many industries . . . especially in furnace and heat-treating operations. In job after job it has set new records for high temperature service.

NICKEL (INCO TRADE MARK) ALLOYS MONEL* • "K" MONEL* • "S" MONEL* • "R" MONEL* • "KR" MONEL* • INCONEL* • NICKEL • "L" NICKEL* • "Z" NICKEL*
*Reg. U. S. Pat. Off.

providing a temperature rise of 100 F, when the engines are operating at 60 per cent maximum continuous power.

Fire-Resistant-Fluid Lines Test

All fluid lines required to be fire resistant shall be capable of withstanding without failure a flame temperature of 2000 F for five min, under test conditions simulating closely the most critical conditions of pressure and flow.

Propeller Tests

The test requirements apply primarily to propellers of conventional design. These requirements shall be varied as necessary in their application to modified propellers or to propellers of unusual design, in order to achieve, as far as practicable, an equivalent standard of safety. The prototype propeller, with its accessories, shall satisfactorily complete the applicable tests prescribed in the following paragraphs, without evidence of failure or malfunctioning. Before starting and after completing the tests, a detailed inspection of the propeller parts, including measurements of wear and distortion, shall be made and recorded.

CENTRIFUGAL LOAD TEST — A test shall be conducted, consisting of one hr of operation of the propeller at such rotational speeds as will demonstrate freedom from serious blade flutter and adequacy of structural strength of: (a) all prototype propellers, and attached accessories, which are not essentially identical with previously approved types; (b) all modified propellers and modified accessories, when such modifications affect the structural strength of any part, or the blade-flutter characteristics of the propeller. Where feasible, such other tests as may be considered acceptable may be substituted for this test.

VIBRATION TEST FOR PROPELLERS WITH METAL BLADES—A test shall be conducted on the prototype propeller, with its accessories, in order to ascertain that the vibration stresses do not exceed values that are safe for continuous functioning when the propeller is operated under all conditions of engine power and propeller rotational speed, on an engine of the type with which its use is intended.

ENDURANCE TESTS FOR FIXED-PITCH WOOD PROPELLERS—The prototype propeller shall be subjected to at least one of the following tests.

(a) a 10 hr endurance block test on an internal combustion engine. During this test, a propeller of the highest pitch and diameter for which approval is desired shall be operated at its proposed rated rotational speed.

(b) A 50 hr flight test. At least five hr of this flight test shall be conducted with the propeller operating at the proposed rated rotational speed. During the remaining 45 hr, the propeller shall be operated at not less than 90 per cent of the proposed rated speed. These flight tests shall be conducted in level flight or in climb.

(c) A 50 hr endurance block test, on an internal combustion engine, at the engine power and propeller rotational speed for which approval is desired. A special propeller of the design for which approval is desired, but with a pitch which will permit its operation at the desired power and speed, may be constructed for this test.

ENDURANCE TEST FOR PROPELLERS OTHER THAN FIXED-PITCH WOOD TYPES—The prototype propeller, with its accessories, shall be subjected to the following test.

(a) An endurance block test of at least 100 hr duration, on an internal combustion engine of the same power and speed characteristics as the engine or engines with which its use is intended. At least 50 hr of this test shall be conducted at the proposed maximum continuous rotational speed and power rating of the propeller. The remaining portion of the test shall be run at the rotational speed and power conditions deemed appropriate, taking into consideration the findings of the vibration test.

If a rating in excess of the maximum continuous power and speed ratings is desired for take-off purposes, an addi-

(*Turn to page 94, please*)

CONSIDER THIS PROPOSAL TO STRETCH YOUR STEEL

•

It Provides for a More Efficient Use of Sheet Steel—More Finished Products per Ton

•

We are assuming that your most pressing problem today, like that of most manufacturers, is how to increase production with a limited amount of sheet steel. And we believe we can help you solve that problem, in part or in whole, through the application of N-A-X HIGH-TENSILE to your operations.

High Physical Properties Take the Place of Mass

The method we suggest to stretch your steel is simple: Let metallurgy take the place of mass. The improved physical properties of N-A-X HIGH-TENSILE, as compared with carbon sheet steels, make it possible to reduce sections substantially without sacrifice of strength. By taking full design advantage of N-A-X HIGH-TENSILE's strength, impact toughness, fatigue- and corrosion-resistance, manufacturers have cut weight and mass as much as 25% in scores of parts and products.

3 Tons of N-A-X HIGH-TENSILE Do 4 Tons of Work

A saving of 25% in sectional mass means that 3 tons of N-A-X HIGH-TENSILE will replace four tons of carbon sheet steel. Four products can be built for every three formerly produced—a 33% production increase. This is entirely feasible in a wide range of applications, for N-A-X HIGH-TENSILE can be cold-formed and drawn to intricate shapes, has excellent weldability, and retains its properties under extremely high temperatures.

Production Economies Make Up for Higher Material Costs

We believe that N-A-X HIGH-TENSILE will compare favorably in price with cheaper steels *on a basis of over-all costs*. The most important economy, of course, is the fact that three tons take the place of four. But in addition, the properties and characteristics of N-A-X HIGH-TENSILE steel often effect substantial savings in handling, fabricating and finishing operations to compensate further for its higher cost per ton.

We would like a chance to work with you on the application of N-A-X HIGH-TENSILE to your production. We believe we can demonstrate that it is the logical steel to use—an effective answer to your current problems.

MAKE A TON OF SHEET STEEL GO FARTHER
Specify—
N-A-X
HIGH-TENSILE STEEL

GREAT LAKES STEEL
Corporation
N-A-X ALLOY DIVISION • DETROIT 18, MICHIGAN
UNIT OF NATIONAL STEEL CORPORATION

tional 10 hr test shall be conducted at the desired take-off rating. Satisfactory completion of 10 hr of operation at the take-off rating will make the type eligible for operation at this rating.

(b) Instead of the block test, the airworthiness of such propellers may be substantiated by operation with an engine undergoing type test in accordance with the requirements prescribed in endurance test for engines. The same ratings approved for the engine undergoing this type test may be approved for the propeller used in conjunction with such tests.

FUNCTIONAL TESTS FOR VARIABLE-PITCH PROPELLERS — The prototype propeller, with its accessories shall be subjected to the following functional tests, which shall be conducted while the propeller is driven by an internal combustion engine mounted on a test stand or in an airplane in flight. The propeller used in the endurance test shall be used for these tests, which, if desired, may be conducted during the course of the said endurance test.

MANUALLY - CONTROLLABLE PROPELLERS — Five hundred complete cycles of control from operation at low rotational speed to operation at the maximum take-off rotational speed and power, then returning to operation at low speed.

AUTOMATICALLY - CONTROLABLE PROPELLERS—Fifteen hundred complete cycles of control by means of the automatic-control mechanism, under the conditions described in the preceding paragraph.

FEATHERING PROPELLERS — Fifty cycles of feathering operation.

REVERSIBLE - PITCH PROPELLERS—Two hundred complete cycles of control from maximum, other than feathered, pitch to maximum reverse pitch. At the end of each cycle, the propeller shall be operated in reverse pitch for a period of two min at the maximum rotational speed and power for which approval for operation in reverse pitch is desired.

ALL VARIABLE - PITCH PROPELLERS—The surge characteristics of the propeller are to be determined, and one period of 10 min duration is then to be run at a propeller rotational speed five per cent in excess of the maximum surge speed so determined.

At the completion of all of the prescribed tests, the propeller, with its accessories, shall be in a condition for continued safe operation without replacement of any parts. During all of the tests, only servicing or minor repairs shall be permitted; except that, when deemed acceptable, major repair or replacement of parts may be resorted to, provided that the parts in question are subjected to additional penalty tests. The extent of these penalty tests shall be dependent upon the nature and extent of the repairs or replacements involved.

Compliance with the foregoing requirements entitles the propeller to a certificate of type approval, which will be regarded as establishing its fitness for installation in an airplane. However, before the airplane in which it is installed can be certificated for the particular operation for which it is intended, compliance with the applicable paragraphs in the section on Powerplant Installation must have been demonstrated, and any prescribed additional flight tests and demonstrations must have been complied with.

Part II will appear in an early issue.

New Motor Oils Announced to American Chemical Society

New motor oils that last longer and make starting easier, which thin on cooling and thicken on heating, were announced to the American Chemical Society by Drs. H. C. Evans and D. W. Young of Stanco Distributors, Inc., New York City.

The special oils, with high viscosity index, are produced by using certain polymers or rubber-like materials, they said in a report presented to the Division of Petroleum Chemistry at the Society's fall meeting.

The research work was done in the laboratories of the Standard Oil Company of New Jersey.

CLASSIFIED ADVERTISEMENTS

ACTIONS

SPEAK LOUDER

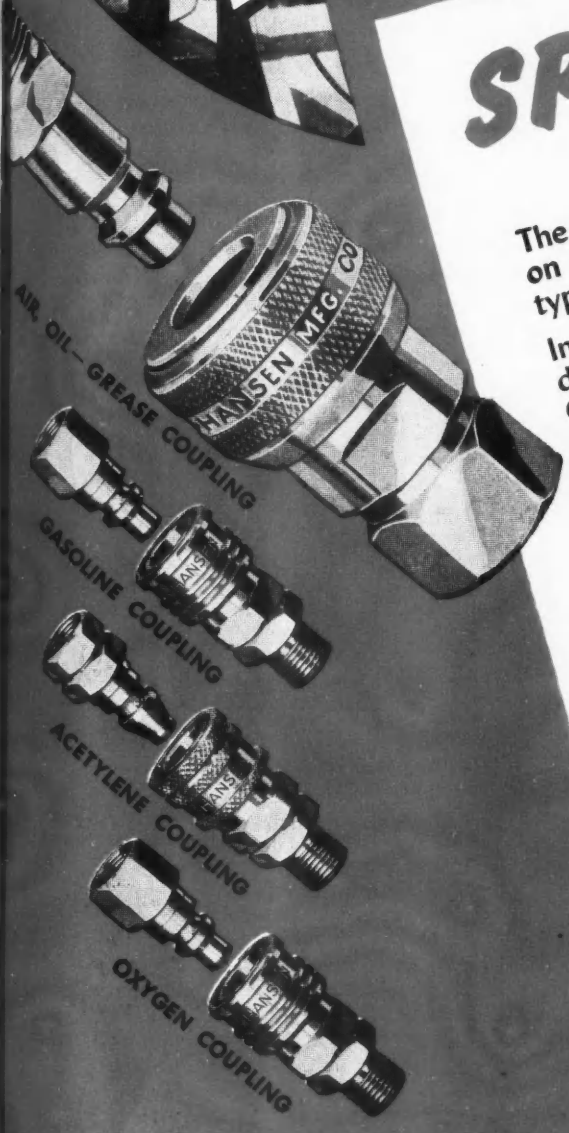
The proof of the puddin' on any piece of equipment rests on its performance, based on everyday use under all types of working conditions.

In plants where peak production plus economical production is a "must" there you will find Hansen Push-Tite Couplings because they save operators' time, save costly air and speed up production.

In large and small plants throughout the country, first choice is predominantly Hansen Couplings and for good reasons. They are simple and easy to operate, save time, effort and material, and will last longer because they are compact and sturdy with all moving parts fully protected. Millions of Hansen Couplings are in daily use in thousands of plants, evidence of their superiority as the best by any test.

The simplicity and ease of operation is unique, to connect the Hansen Push-Tite Coupling you simply push plug into socket, it is locked and immediately the air is automatically turned on. No twisting or turning to lock and connect, just a slight push of plug. To disconnect, slide sleeve back with thumb, it is unlocked, disconnected and air is automatically shut off. Complete swivel action prevents kinking of hose

Send for free industrial catalog.



HANSEN MANUFACTURING CO.

1786 E. 27 ST., CLEVELAND 14, OHIO

New Products

(*Continued from page* 52)

finish on parts delivered to them.

The recorder attaches at the meter jack provided on all Profilometers. No adaptations of existing Profilometer equipment are necessary.

Hollingshead Develops New Packaging Plastic

A new packaging plastic, known as Cocoon and consisting of modified film-forming vinyl resins carried in volatile solvents, is a recent development of the Coatings Division of R. M. Hollingshead Corp., Camden, N. J. The plastic packaging process is generally carried out by spray application, although for some types of work dipping is a more practical means of application.

The spray packaging method is a simple and quick means of packaging parts, assemblies, or complete machines —regardless of size or complications in shape. It consists of an initial spray operation which bridges large openings and voids with long web-like plastic filaments that completely enclose the item being packaged. Subsequent spray applications produce a tough, flexible moisture impervious package which is said to withstand exposure to wind, rain, snow, and sunlight over long periods.

Applying Cocoon packaging plastic

Automatic Timer

Photoswitch, Inc., 77 Broadway, Cambridge 42, Mass., is introducing an automatic timer for intervals from 1/20 sec to four min. It is used to control such equipment as spot welders, grinders, honing machines, drilling machines, conveyors, automatic filing machines, and photographic printers. Known as the Type 3OHL1, the new timer provides four basic types of timing—interval, delayed action, automatic repeat, and programming, as well as variations of these four fundamental types.

Photoswitch Type 30HL1 timer

Flexibility of the unit is obtained by bringing out many points of the circuit to terminals on the front panel. The basic circuit is self-compensating for changes in the line voltage. For this reason, accuracy does not change from

(*Turn to page* 98, *please*)

SUPERIOR ABRASION RESISTANCE

Parts made from HYCAR synthetic rubber have 50% greater abrasion resistance than parts made from natural rubber. That means they'll last longer, give more dependable performance in the most severe service, and save maintenance and replacement time.

But that's only one of HYCAR's unusual and valuable properties. Examine the list in the box at the right. Think of these properties in terms of your requirements of rubber parts. Realize that these properties may be had in an almost limitless number of combinations, each designed to meet the specific service conditions of the finished part.

We have developed more than 5000 recipes for HYCAR compounds — each compound engineered to do a certain job. If you're looking for rubber parts that will give long life, dependability, and economical operation, *specify HYCAR.*

Ask your supplier for parts made from HYCAR. Test them in your own applications, difficult or routine. You'll learn for yourself that it's wise to use HYCAR for long-time, dependable performance. For more information, please write Department HH-9, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio.

CHECK THESE SUPERIOR FEATURES OF HYCAR

1. *EXTREME OIL RESISTANCE — insuring dimensional stability of parts.*
2. *HIGH TEMPERATURE RESISTANCE—up to 250° F. dry heat; up to 300° F. hot oil.*
3. *ABRASION RESISTANCE—50% greater than natural rubber.*
4. *MINIMUM COLD FLOW—even at elevated temperatures.*
5. *LOW TEMPERATURE FLEXIBILITY—down to —65° F.*
6. *LIGHT WEIGHT—15% to 25% lighter than many other synthetic rubbers.*
7. *AGE RESISTANCE—exceptionally resistant to checking or cracking from oxidation.*
8. *HARDNESS RANGE—compounds can be varied from extremely soft to bone hard.*
9. *NON-ADHERENT TO METAL—compounds will not adhere to metals even after prolonged contact under pressure. (Metal adhesions can be readily obtained when desired.)*

Hycar

Reg. U.S. Pat. Off.

LARGEST PRIVATELY PRODUCED BUTADIENE TYPE

Synthetic Rubber

B. F. Goodrich Chemical Company

A DIVISION OF THE B. F. GOODRICH COMPANY

day to day, nor does replacement of the vacuum tube alter the original two per cent limit of accuracy variation. Either a 115 volt or 230 volt supply line may be used.

Finishing Process for Small Parts

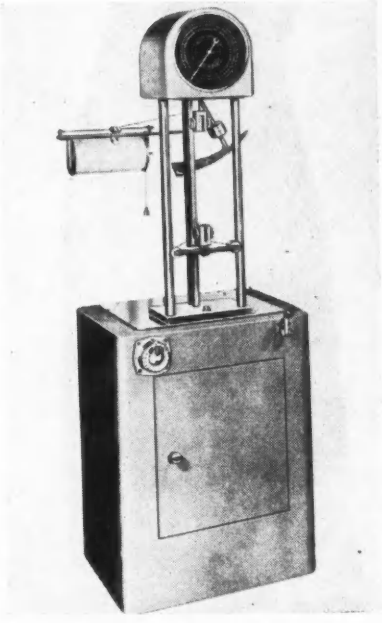
Britehoning—a new mechanical finishing process for small parts—is offered to the finishing industry as an improved mechanical method of processing small stampings, forgings, machined parts, extrusions, die castings and sand castings by the Sturgis Products Co., Sturgis, Mich.

The process is basically a tumbling method involving the use of mineral chips and suitable compounds for developing a fine semi-lustrous finish on practically all types of metal parts. It is suited as a pre-plating operation for finishing small zinc based die castings or brass stampings prior to bright nickel and chrome plating. Steel and aluminum parts can be finished by the same procedure with satisfactory results. Parts to be finished can be processed directly after the forming or trimming operation, providing the die marks or stretcher marks do not penetrate too deeply into the surface of the part. Die castings, if closely trimmed, may be processed as received from the trim die, but if the trimming is not close, a polishing wheel or abrasive belt operation may be necessary to remove this prior to Britehoning.

Low-Range Tester for Light Materials

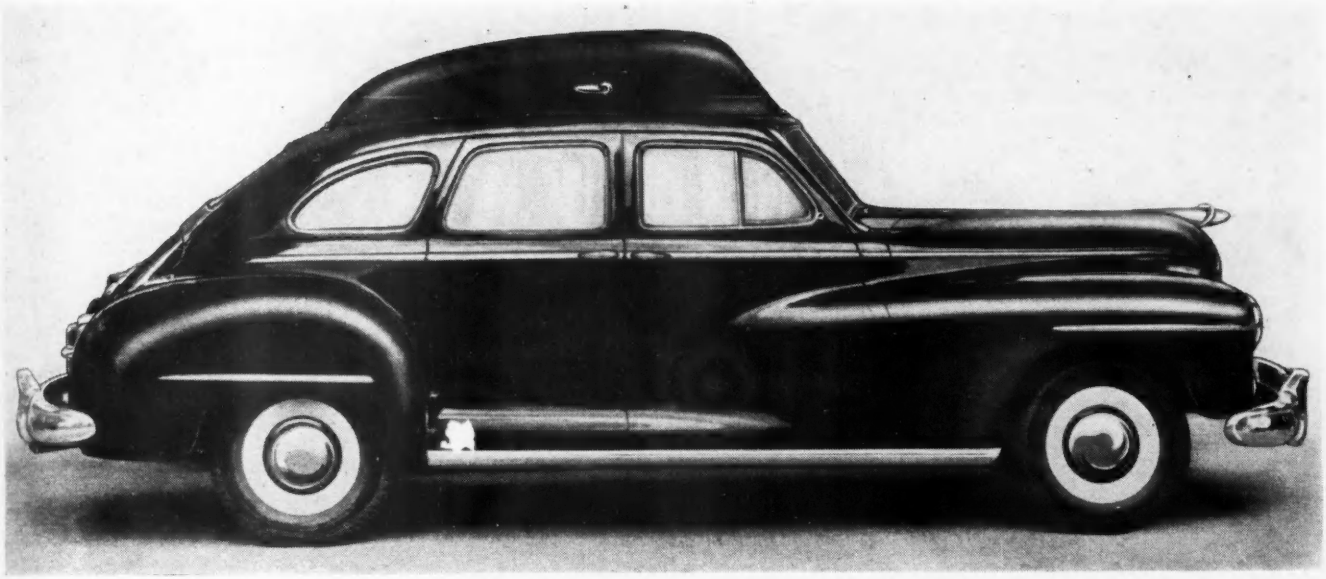
A low-range tester, designed for light materials and small finished items, is now in production at W. C. Dillon &

(*Turn to page* 100, *please*)

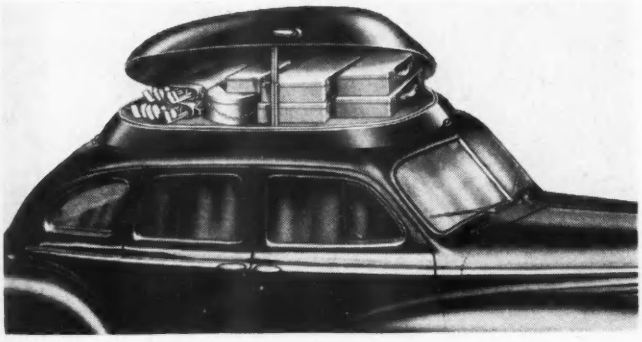


Dillon low-range tester

MANUFACTURING AND SALES RIGHTS AVAILABLE



This Carry-All Luggage Carrier (Patent Pending) which fills a long felt need for the Tourist, Farmer, Hunter, Camper, Fisherman, Salesman, etc., and which promises to be a large volume item is available for manufacture and sales on a royalty basis.



This streamlined all-metal weatherproof carrier can be formed from sheet aluminum or other metal.

Correspondence invited from interested manufacturers and/or merchandisers.

W. E. MARTIN

Kewanee, Illinois

Co., Inc., 5410 W. Harrison St., Chicago 44, Ill. It incorporates four separate capacities, each of which is shown individually on the dial. These ranges are: 0-10 lb in 1-oz dial divisions, 0-25 lb in 2 oz divisions, 0-50 lb in 4-oz divisions, and 0-100 lb in 8-oz divisions.

Travel of the lower grip of the tester is continuously variable from 0 to 19 in. per min. Other features are: Pendulum action; maximum load reading; featherweight, swivelled upper grip; stroke-limiting switches; forward-reverse switch; stress-strain recorder; and elongation gage. Overall height is 63 in. and net weight 162 lb.

Solid Kennametal Extruded Rounds Introduced

Kennametal Inc., Latrobe, Pa., is now manufacturing a line of solid Kennametal extruded rounds, which are available in two straight tungsten carbide grades, KE5 and KE7, with a Rockwell hardness of 89.0 and 91.0, respectively.

These rounds have been developed primarily for use as wear-resistant elements, and are suitable for such applications as guides, feeding fingers for automatic machines, rollers, guide rails, laps, scribers, points for engraving tools, thread checking wires, etc.

They are available, either rough extruded or centerless ground, in diameters of 1/32, 1/16, 3/32, ⅛, 5/32, 3/16, 7/32, and ¼ in., and in standard lengths in even inches from one in. to 10 in. Intermediate diameters can be furnished.

Vibro-Insulators in Three New Types

Three new Vibro-Insulators, devices of rubber and metal to cushion industrial and manufacturers original equipment of all types, have been added to the line of the B. F. Goodrich Company, Akron, Ohio. The three new products are listed as No. 130, 133, and 144.

Recommended by the manufacturer for use as feet or bumpers for portable machinery, tables, blowers, fans, pumps, etc., the rubber is of 45 durometer hardness and is said to give quieter operation, greater stability of equipment and vibration absorption.

Type 130 carries maximum recommended load of 132 lb with the maximum deflection at that load 3/16 in. and the minimum disturbing frequency 1200 per minute. Maximum recommended load for type 133 is 180 lb, maximum deflection at that load 5/32 in. and minimum disturbing frequency 1200 per minute. Type 144 is recommended for a maximum load of 60 lb, maximum deflection at that load is ⅛ in. and minimum disturbing frequency 1350 per minute.

Two Fuses for Industrial Hydraulic Systems

Simmonds Products, Inc., 21-10 49 Ave., Long Island City 1, N. Y., is making an improved type quantity measuring fuse and a new return flow fuse for industrial hydraulic systems.

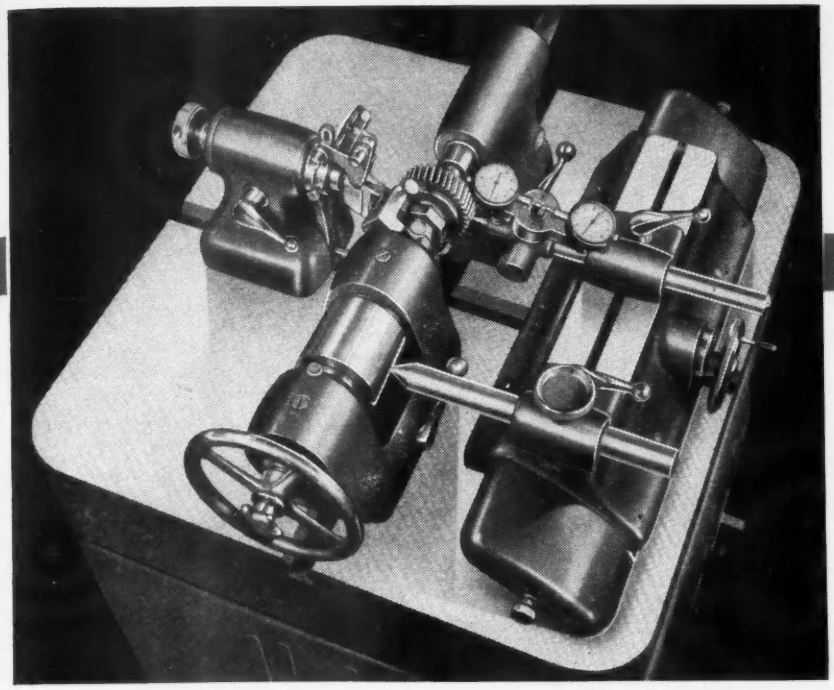
Both types of Simmonds fuses serve as safety shut-off devices, designed to provide protection in the event of a break or rupture in the hydraulic line, and neither fuse affects the normal operation of the system. The quantity measuring fuse is designed to shut off after a predetermined amount of fluid has passed through it, and gives protection to individual actuating cylinders.

The Simmonds return flow fuse is designed to protect a section of, or an entire hydraulic system. Installed between the pressure and the return lines, this type fuse shuts off only if a break in one of the two lines causes a pressure drop below predetermined values.

Fuses for lines from ¼ to ¾ in. OD are available. The quantity measuring fuse is available in capacities from 5 to 100 cu in.

New Renault Car Has Rear-Mounted Engine

The Renault company in France has announced a new economy car of four-passenger size and weighing 1150 lb. It is powered by a rear mounted 19-hp four-cylinder engine of 46.5 cu in. piston displacement.



Check GEAR TEETH for DIMENSIONAL ACCURACY

The Red Ring Universal Gear Checker is an instrument for quickly and accurately checking the dimensional errors of both spur and helical gear teeth—such errors as index, helical angle, lead, parallelism, tooth size, eccentricity, interference and wobble.

The various heads used on this instrument are so ingeniously designed that the human error in their use is practically eliminated. Consequently, the average shop man can inspect gears quickly and accurately. It doesn't require a skilled inspector.

CAPACITIES OF RED RING GEAR CHECKERS:

12″ for gears ¼″ to 12-1⅛″ O. D. • 18″ for gears 2″ to 18-⅞″ O. D.
24″ for gears 3″ to 25-½″ O. D.

Alterations can be made for special applications

NATIONAL BROACH AND MACHINE CO.

5600 ST. JEAN RED RING ◯ PRODUCTS **DETROIT 13, MICH.**

SPECIALISTS ON SPUR AND HELICAL INVOLUTE GEAR PRACTICE

ORIGINATORS OF ROTARY SHAVING AND ELLIPTOID TOOTH FORMS

New Production Equipment

(*Continued from page* 46)

Drying time is usually from 4 to 6 minutes.

The Optimus continuous cold and hot air dryer can be used as a single-stage dryer or in connection with a number of successive operations, alkaline, acid, or neutral. The manufacturer states that it is most efficient as a stainless dryer, although other uses are practical.

The cold air system includes a blower and a series of nozzles. The hot air system includes an air-heater, re-circulating blower, a damper to adjust the mixture of the atmospheric air and re-circulating air, and the necessary nozzles.

THE DoALL CO., 1301 Washington Ave., So.,Minneapolis 4, Minn., has developed a spray lubricator for use with its high-speed band saws. The attachment is said to be simple to install. It operates from a standard air pressure line.

The spray head straddles the saw blade from the back side and directs twin streams of lubricated air against the teeth of the saw. Lubricant is thus

DoAll spray lubricator for band saws

forced under pressure in the form of metered mist into the teeth of the saw as it enters the work. Use of coolant is regulated by a metering valve.

The DoAll spray lubricator has been designed primarily for use in cutting non-ferrous metals, and is said to work equally well on many types of plastics and laminated material where friction between blade and work softens the material to a gummy state.

Ford Buys Wheels From West Coast Firm

In line with Ford Motor Company's announced program of decentralization, a contract has been signed with the Norris Stamping and Manufacturing Co., Los Angeles, to provide passenger car wheels for Ford's western assembly plants.